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TO ADVERTISERS

CHANGES for advertisements should be in this office by Friday noon for the following week's issue.
NEW ADVERTISEMENTS should be in the office not later than Monday noon to insure publication in that week's issue.

This is the last month of the Pan-American Exposition, which closes November 1. Perhaps more than any other exposition that has ever been held this one has signalized and marked the electrical epoch in civilization. Apart from the great beauty of its buildings and grounds and the general interest of the exhibits gathered in them, the electrical features of the exposition have been so remarkable that they have elicited from all sides a most general and hearty approbation. To those, therefore, who have not yet seen the marvelously beautiful lighting effects which form the crowning glory of the Pan-American it is urged that they should not miss the opportunity for seeing a sight which certainly has never been even approached in splendor and beauty and which, due to the peculiar conditions of the exposition's situation and surroundings, will almost certainly never again be rivaled.

THE AMERICAN STREET RAILWAY ASSOCIATION.

Next week there will assemble in New York city the annual convention of the American Street Railway Association, which is probably the most representative body of American business men engaged in a public-service industry that follows the custom of holding conventions. When the electric railway was introduced to the American public by Mr. Frank J. Sprague, some fourteen years ago, it could never have been conceived, even by its most ardent promoters, that within that short space of time the industry would enlist the investment of more than a billion dollars in capital and the active services of some of the strongest and ablest men in the country. The men who form the membership of this association are those who have built the splendid industry of the electric railway and they reckon among their number many whose position in engineering, financial and executive circles is the very highest.

To these representatives of a great industry the city of New York, as well as the electrical professions and trades represented in it, extends the most cordial welcome. Following the tradition of past years it is believed that much will be learned from the gathering and that the subjects brought up for discussion and conference will be of the usual high class and great interest. At the earlier sessions of this association, shortly after its formation, no subjects of an electrical character were discussed, for the ubiquitous motive power of street railways in those days was the horse or the mule. It is interesting to look back at the early record of the association and see how papers on bran-mash and epizootic, pink-eye, horse-shoe nails and such subjects have given way to topics of the most professed electrical engineering interest. Some of the best and most interesting papers dealing with the management and operation of electric systems that have made their appearance in this country have been read at former meetings of this association. It is believed that the programme for this meeting will be quite as interesting as that of any of its predecessors.

THE FUTURE OF RAPID TELEGRAPHY.

The activity of inventors of rapid telegraph apparatus seems to be as great as ever, and only last week it was reported that two Hungarian inventors are working a three hundred and seventy-five-mile line in eastern Europe at a speed of forty thousand words an hour. A number of systems have been devised for rapid telegraph working, one of the most interesting and ingenious among them being that of Mr. Patrick B. Delany, which was illustrated in the ELECTRICAL REVIEW last week. It is practically certain that we have to-day, either actually developed or else so nearly developed that only the necessary reduction to practice which comes from application on an extended scale is necessary to make it perfect, systems fully equipped for working several hundred times as rapidly as the ordinary Morse system in general use. The most interesting feature of this subject is the effect that the general introduction of rapid telegraph methods will have upon the business and other affairs of the country.

For many years after its introduction the telegraph was considered a high-priced luxury and was used only under such conditions as rendered other means of communication impossible, and where, on account of its speed, a vital gain was made over the slower method of communication by mail. With the extension of telegraph facilities and the consequent great reduction of rates, the telegraph has come more and more to be used as an adjunct of the regular correspondence of commercial and other institutions, and to-day the land lines and ocean cables carry no inconsiderable part of the total correspondence of the world. But not-

withstanding the immense volume of business that is done over them, still a very large majority of the total bulk of correspondence is done by mail, involving a necessary delay. This age, of all others, is the one in which time-saving apparatus has found its greatest usefulness, and where every method of saving a minute or an hour is eagerly seized upon and practised to an extent determined solely by its cost in comparison with slower methods.

If it is possible to increase a thousandfold the capacity of a telegraph line for conveying messages, it is perfectly evident that the cost of sending messages may very greatly be reduced, although probably not in anything like the same proportion. Assuming, however, that the cost for ordinary commercial messages or letters would be reduced tenfold while the present delivery speed of the telegraph is maintained, it is evident that the mail as a method of conducting ordinary correspondence would soon go out of vogue. In other words, the telegraph would carry the great bulk of the business correspondence of the world, leaving the slower mail for such messages as require enclosures or for reasons of law or business requiring autograph signatures attached to them.

It seems, from this view of the matter, that there is no more interesting development possible in telegraphy than the utilization of some of the high-speed methods making possible this enormous extension of telegraph service. The saving in time is only a measure of the gain in effectiveness and celerity in business methods which would be accomplished by this means. How much available energy is wasted and time is lost in waiting for mail replies is not capable of calculation, but every one knows from his own experience that it is very large and that the general use of telegraphic methods at low cost would reduce this loss to an inconsiderable minimum. The subject is particularly fascinating and it is to be hoped that the telegraph companies who are, after all, most particularly concerned in this matter, will not fail to consider the reaction upon the volume of their own earnings which must follow the extension of the telegraph into the daily and usual channels of ordinary commercial correspondence.

WATER-WHEEL REGULATION.

There is a growing tendency throughout North America to make use of natural forces in the shape of water powers wherever these are available, and by recent improvements in electrical engineering many waterfalls hitherto considered unavailable for industrial purposes have been set to work and are factors of considerable economic importance. With the general utilization of such water powers there has arisen a number of very interesting engineering questions concerning the regulation of water-wheels for speed, especially where the latter are coupled with polyphase generators working in multiple. It is not often realized that where such machines are employed working in parallel the electrical coupling between the generators is almost as rigid as if their armatures were mounted on the same shaft, and that any strain on this—that is, any tendency of the prime motor of one machine to drive it faster or slower than the other machine—imposes a penalty in exchange currents of great volume, causing undue heating and waste of energy. It has been the almost habitual practice to equip water-wheels, when these are worked in gangs, with independent governors of one type or another, but it has always been noticed that under such circumstances, with normal load, several of the wheels run full head while generally one governor does all the governing. Under light load it not infrequently happens that several of the governors shut down their wheels entirely, while others open wide, making their wheels drive the attached dynamos not only for the generation of power current for the line, but also to work the other dynamos as motors, uselessly churning the attached wheels in their cases.

Water power is by no means as flexible as steam power, nor as susceptible to exact regulation. The difficult question of momentum of a moving column of water has generally to be considered, and except in the case of impulse wheels working under high heads, where regulation is accomplished by deflection of the water jet, such accurate results as are obtainable in steam practice have not generally been secured. There are on the market a number of most excellent water-wheel governors, operating by auxiliary mechanical or electrical devices, and these are admirable machines where a single wheel operating a single generator is concerned. But where the more difficult problem of parallel operation is considered it is probably fair to say that even the best governors and the best systems of water-wheel regulation now in general use exhibit considerable room for improvement.

There has been practised to a slight degree in Switzerland and in some parts of the United States a method of regulation which, when water power is abundant, as it generally is, seems to possess many qualities of great value. This method consists in regulating the load upon each wheel, leaving the water-gates unchanged. Naturally the method is electrical, and consists either of adjusting resistances in circuit with the dynamo connected with the water-wheel or else of driving an iron disk so surrounded by magnets of variable intensity as to dissipate the surplus energy of the wheel in the formation of eddy-currents in the disk.

It is not amiss in this connection to call the attention of engineers constructing water-power plants to the extraordinary flexibility and simplicity of regulation which may be attained in this way. The regulating mechanism is too simple to require description and consists only of a sensitive centrifugal control apparatus operating a relay which controls the amount of load thrown over to the resistance system. While such a method of regulation is naturally wasteful of water, it most often happens that an abundance of water is at hand and its waste is a purely secondary consideration. The subject is one that is well worth investigation and some account of the success attending the installations mentioned above would be of great value as well as of high interest to the engineering profession at large.

Science Brevities

Testing of Three-Phase Generators—An article on this subject has been published by M. Breslauer, in the *Zeitschrift Elektrotechnische,* Vienna, and digested in *Science Abstracts* as follows: A complete test of a large three-phase generator is frequently attended with difficulties on account of having to provide the necessary large amount of power and the three equal non-inductive load resistances. On a non-inductive load, which is the load generally employed in carrying out such a test, the drop from no load to full load should not exceed three per cent in good machines of moderate output, and should not in any case be greater than six per cent. A very good estimate of the qualities of a machine may, however, be arrived at without actually running the machine at full load by making use of the open-circuit (exciting current and voltage) and short-circuit (exciting current and armature current on short-circuit) characteristics. In order to find the load characteristic of the machine under constant excitation (the load being non-inductive) a right-angled triangle is constructed whose hypotenuse is equal to the constant exciting current, and one of whose sides is equal to the exciting current required to produce the given load current on short-circuit. The point on the open-circuit characteristic corresponding to an exciting current equal to the remaining side of the right-angled triangle then gives the terminal potential difference at that load. The author tested this theoretical method on a machine giving very bad regulation (and, therefore, very suitable for the purpose) and found practically perfect agreement between theory and experiment.

Capacity of the Human Body—An article upon this subject, by G. de Metz, is digested in the London *Electrician* as follows: Bodier placed the electric capacity of the human body at 0.0025 microfarad and Dubois at 0.1650 microfarad. Both these figures are much in excess of the true capacity according to the recent researches of G. de Metz. The latter measured the capacities of several persons under all sorts of conditions, and found that the capacities were the same in the nude and when dressed in close-fitting conducting material. The obvious conclusion is that the capacity of the human body is the same as that of a metallic body of the same dimensions, and this conclusion is fully substantiated by the other measurements. The capacity remains the same for any charge between 100 and 1,000 volts, but differs from one person to another in accordance with the volume and shape of the figure. It changes rapidly when the person is surrounded by metallic surfaces, and also greatly depends upon the pose. Thus the value of 87.8 cm. was obtained in an upright position, 76.0 cm. when crouched, and 91.2 cm. when erect with one arm stretched upward. When placed on a rubber mat and surrounded by a zinc cylinder 138 cm. in diameter the capacity was 180.7 cm., and it rose to 217.9 cm. on reducing the diameter of the cylinder to 68 cm. The normal value for an erect pose in the centre of a hall is 0.00011 microfarad for an individual of average stature.

Drop in Alternators—The following digest of an article on the "Predetermination of Drop in Alternators," by G. Giles, which appeared originally in *L'Eclairage Electrique,* is given in *Science Abstracts* for August: "The author develops a method of calculating the drop of potential difference in alternators which is based mainly on the consideration of the reluctances of the air-gap and the leakage paths. Let the open-circuit characteristic of the alternator be given. If R_1 = reluctance of air-gap (corresponding to useful flux), R_2 = reluctance of leakage paths, $S\,i$ = demagnetizing ampere-turns due to armature when the power factor is zero, and if we suppose that the total magnetic flux through the field core is the same as it was on open circuit; then in order to pass from any point on the open-circuit characteristic to a corresponding point on the internal characteristic, we have to reduce the volts by an amount corresponding to the flux $\frac{4\pi}{10} \cdot \frac{S\,i}{R_1 + R_2}$, and to increase the ampere-turns by an amount $S\,i\,\frac{R_2}{R_1+R_2}$. In order to find the external characteristic we have further to subtract from the ordinate of the internal one an amount corresponding to the impedance drop in the armature. In order to obtain this latter correctly, the author uses an experimental armature coil of very fine wire superposed on the main coil and connected to a voltmeter. If the alternator is run on short-circuit with a current corresponding to the load current, the true impedance drop is easily found from the voltmeter reading and the number of turns in the exploring and main armature coils. The author next investigates the effect of damping coils, and shows that if damping is perfect, then the armature back turns are (power factor = 0) given by $\frac{1}{2}\,SI_0$, where I_0 is the maximum value of the armature current (sine function assumed). If there are no damping coils, then the electro-motive force of the alternator when loaded contains a third harmonic, even if the open-circuit electro-motive force is a pure sine wave. The results are applicable to two and three-phase machines, the back armature turns of which are (power factor = 0) given by SI_0 and $\frac{3}{2}\,SI_0$ respectively. Experimental results are given in support of the theory developed."

Nernst Lamps—An excellent article has recently appeared in the *Electrotechnische Anzeiger,* which gives an account of experiments made with three commercial 220-volt, 200-watt Nernst lamps. These lamps, it would seem, were continually tested until they failed, and their lives were recorded at 124,293 and 369 hours, respectively. All three lamps were destroyed because the glower feeding wire melted close to the incandescent body. The results of photometric tests of the lamp, the life of which was 369 hours, were also given in this article. The voltage was continually 220 volts. The candle-power dropped from 146 candles at the start to 99, after 100 hours; 81, after 220 hours; 60, after 300 hours, and 48, after 350 hours, the watts consumed per candle being 1.33, 1.91, 2.19, 2.68 and 2.89, respectively. In practice it seems preferable to use a lamp not more than 200 hours—*i. e.,* down to about 80 candles.

Electrical Conductivity of Gases—A paper on the "Electrical Conductivity in Gases Exposed to the Action of Cathode Rays," by J. C. McLennan, recently published in the *Zeit. Physikal Chem.,* is abstracted in the *Journal* of the Chemical Society, for September, as follows: "The conductivity of gases under the influence of cathode rays may be completely explained on the hypothesis that positive and negative ions are produced in the gas. By the action of cathode rays on an insulated conductor positive charges are completely dissipated, while uncharged or negatively electrified conductors retain a residual negative charge. In the author's experiments the effects are due, not to the Rœntgen, but to the cathode rays. Methods for the determination of the extent of the ionization in gases are considered, and experiments with air, nitrogen, carbon dioxide, hydrogen and nitric oxide show that the ion concentration with constant cathode rays is proportional to the density of the gas and independent of its chemical nature. Ionization in the same gas at different pressures is similarly proportional to the pressure, while in all cases it is further shown that the ionization is directly proportional to the energy absorbed.

Selected Chapters in Electrochemistry.

By Harry C. Jones.

(Concluded.)

CHAPTER VII—CALCULATION OF THE ELECTRO-MOTIVE FORCE OF ELEMENTS.

PART III.

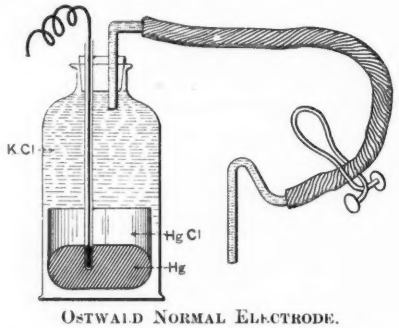
DETERMINATION OF THE SOLUTION-TENSIONS OF METALS.

It is not necessary to know the values of the solution-tensions of the metals used as electrodes, in order to calculate the electromotive force of elements in which the same metal is used on both sides of the cell. This will be seen by examining the equation for the electromotive force of such cells. The solution-tension of the metal used is of the same value on the two sides of the cell, and when the potentials on the two sides are subtracted, the two equal values have opposite signs and, therefore, disappear from the equation.

If, however, we are calculating the electromotive force of an element in which two different metals are used as the electrodes, it is necessary to know the values of the solution-tensions of both metals, since both values appear in the final equation. That such must be the case, can be seen at once from the fact that the two solution-tensions of the two metals have different values, and when the two potentials are subtracted these two different values do not disappear. We must now study carefully the method employed in determining the solution-tensions of the different metals.

We have seen that when a metal is immersed in a solution of one of its salts, a difference in potential between the metal and the solution results, the magnitude depending upon the solution-tension of the metal and the osmotic pressure of the metal ions in the solution. A number of methods have been devised for *measuring such differences in potential between metals and electrolytes.* The one in which the drop-electrode was employed can only be referred to.* The one which we shall study in some detail involves the use of the "normal electrode."†

"This method is based upon the use of an electrode whose potential is known. This is connected with the metal immersed in the solution whose difference in potential it is desired to measure, and the electromotive force of the whole combination determined. Since the potential of the normal electrode is known, that between the metal and the solution in which it is immersed is determined at once; the electromotive force of the two sides when combined, being the difference between the potentials on the two sides. The form of normal electrode used by Ostwald is shown in the accompanying sketch. The bottom of a glass tube, about eight centimetres high and two to two and one-half centimetres in diameter, is covered with mercury. The mercury is covered with a layer of mercurous chloride, and the vessel is then filled with a normal solution of potassium chloride. A platinum wire protruding beyond the end of a glass tube into which it is fused, dips into the mercury and serves as one electrode. The other glass tube passing through the cork, is also filled with normal potassium chloride. The glass tube at the end of the rubber tube dips into the liquid, whose potential, against a given metal immersed in it, is to be measured.



OSTWALD NORMAL ELECTRODE.

"The metal immersed in the liquid serves as the second electrode.

"The electromotive force of the whole system is now measured. Knowing the potential on the one side, that on the other is obtained at once. The potential of the normal electrode just described is 0.56 volt. The metal is positive, the electrolyte negative, which means that there is a tendency for the mercury ions present to separate from the solution as metallic mercury, and this is expressed in potential by 0.56 volt. In such measurements the potential of the metal is taken as zero, and that of the electrolyte expressed as either positive or negative. The potential of our normal electrode is, then, 0.56 volt.

"Differences of potential between metals and electrolytes can be readily measured by means of this normal electrode. Let us take as an example, the difference in potential between magnesium and a normal solution of magnesium chloride. The normal electrode is connected with the normal solution of magnesium chloride, into which a bar of magnesium dips. The electromotive force of this system was found to be 1.791 volts. The electromotive force of this element, as we know, is expressed thus:

$$\pi = \frac{0.058}{v} \log \frac{P}{p} - 0.058 \log \frac{P_1}{p_1}$$

where P is the solution-tension of magnesium, p the osmotic pressure of the magnesium ions in the solution, 2 the valence of magnesium, P_1 the solution-tension of mercury, and p_1 the osmotic pressure of the mercury ions in the solution.

"We have seen that $0.058 \log \frac{P_1}{p_1} = -0.56$ volt, and substituting this value in the above equation we have:

$$\frac{0.058}{v} \log \frac{P}{p} = 1.791 - 0.56 \text{ volt} = 1.231 \text{ volts.}$$

Therefore;

$$0.029 \log \frac{P}{p} = 1.231 \text{ volts;}$$

which is the difference in potential between magnesium and a normal solution of magnesium chloride."

Differences of potential between a number of metals and normal or saturated solutions of their salts, have been measured by Neumann* a few of whose results are given below:

	Sulphate.	Chlor de.
Magnesium	+ 1.239	+ 1.231
Aluminum	+ 1 040	+ 1 015
Zinc	+ 0.524	+ 0 503
Iron	+ 0.093	+ 0.087
Nickel	— 0.022	— 0.020
Copper	— 0.515	.....
Mercury	— 0.980	.....
Silver	— 0 974	.....
Gold	....	— 1 356
Platinum	.....	— 1 066

The above data show that essentially the same results are obtained whether the sulphate or chloride is used, and this raises the question as to what effect the *nature of the anion has on the difference in potential between the metal and the solution.* This problem was studied extensively by Neumann, who worked with a large number of salts of thallium, indeed 23 in all, and measured the difference in potential between the metal and

* Ostwald; *Ztschr. phys. Chem* , i, 583.

† The following account of the use of the normal electrode in measuring differences of potential between metals and electrolytes is taken from Elements of Physical Chemistry, by H. C. Jones, which will be published in the near future.

* *Ztschr. phys. Chem.* xiv, 229.

its solutions. He concluded that for equally dissociated substances the nature of the anion has no influence on the potential difference.

We now come to the final and most important part of the problem, the *calculation of the solution-tension of metals* from the difference in potential between the metal and the solution of one of its salts. This difference in potential is due, on the one hand, to the solution-tension of the metal, and on the other, to the osmotic pressure of the metal ions in the solution. These forces act in opposition to one another, and the result is the formation of a double layer, which assists the weaker force, and the result is the difference in potential with which we have been dealing. If we measure this difference in potential, and know the osmotic pressure of the cations in the solution, we can readily calculate, from considerations already developed, the solution-tension of the metal in question.

The difference in potential between a metal and a solution of one of its salts in which it is immersed is:

$$\pi = \frac{0.058}{v} \log \frac{P}{p}$$

where v is the valence of the cation, P the solution-tension of the metal, and p the osmotic pressure of the metal ions in the solution. If we know π, v, and p, we can, of course, calculate P,

$$\log P = \frac{\pi v}{0.058} + \log p.$$

The solution-tensions of a few* of the more common metals, as calculated by the method just described, are given below:

Magnesium	10^{44}	atmospheres.
Zinc	10^{18}	"
Cadmium	10^{7}	"
Iron	10^{3}	"
Lead	10^{-2}	"
Copper	10^{-9}	"
Mercury	10^{-16}	"
Silver	10^{-15}	"

We are impressed by the magnitudes of the solution-tensions of the metals. For metals like magnesium, aluminum, zinc, and the like, they are almost inconceivably great, while for metals like copper, mercury, silver, gold, platinum, and the like, the solution-tensions are of infinitesimal value.

The enormous magnitude of the one, and the inconceivably small values of the other metals, would lead one to conclude at first that there must be some error in the method employed in calculating the solution-tensions of the different metals. When, however, these values are introduced into the equations for the electromotive force of elements, the results as calculated agree very satisfactorily with those found by experiments. The above is a strong argument in favor of their general correctness.

* For a fuller list of solution-tensions, see Le Blanc, Elektrochemie.

ARE THE SOLUTION-TENSIONS OF THE METALS CONSTANT?

The question naturally arose as to whether the solution-tensions of the metals are constants for the different metals, or are they affected by the conditions to which the metals are subjected? Ostwald, who has developed this conception much farther than any one else, concluded in the second chapter of his "Lehrbuch" that the solution-tension of a metal is as constant for the metal as its atomic weight. He regarded it as independent, even of the nature of the solvent in which the metal was immersed.

Light was thrown on this problem in an unexpected manner by work which was done by Jones in Ostwald's laboratory. An element was constructed containing on the one side a tenth-normal solution of silver nitrate in water, and on the other a tenth-normal solution of silver nitrate in ethyl alcohol. The first object in mind in constructing such an element need not be considered here. It was known that silver nitrate is dissociated by water to a much greater extent than by alcohol, and that, consequently, for solutions of the same concentration the aqueous solution contains many more silver ions than the alcoholic. The osmotic pressure of the silver ions in the aqueous solution would, therefore, be much greater than in the alcoholic solution. The solution-tension of the metal in the two solvents was assumed to be the same.

From these data it would be a perfectly simple matter to determine which side of the element would be positive and which negative; that pole would, of course, be positive on which silver ions were separating in the form of metal. Since the solution-tension of the metal is the same on both sides of the cell, metal ions will separate from the solution on that side on which the osmotic pressure of the metal ions is the greater. We have just seen that the osmotic pressure of the silver ions in the aqueous solution is the greater; consequently, the pole immersed in the aqueous solution of silver nitrate would be the positive pole.

The cell was constructed as described, and an attempt was made to measure its electromotive force. The first fact which was discovered was that the pole immersed in the alcoholic solution of silver nitrate was positive. This was very embarrassing, and, at first, seemed entirely inexplicable. A number of experiments were repeated and all gave the same result. The facts were undoubtedly not in accord with the assumptions which had been made. What was to be done? It was obvious that there was something wrong with the assumptions. We then convinced ourselves beyond all question, that silver nitrate in water is much more strongly dissociated than in alcohol at the same concentration. This left but one assumption untested, and that was, that the solution-tension of the metal is a constant in the different solvents. This assumption must then be wrong, and the experiment was so carried out as to determine the relative solution-tensions of silver in an aqueous and in an alcoholic solution of silver nitrate.

The element was constructed, using a tenth-normal solution of silver nitrate in water on the one side, and a tenth-normal solution of silver nitrate in alcohol on the other side. The electromotive force of the combination was measured, and from this the relative solution-tensions calculated as follows: The potential in the alcoholic solution is expressed thus:

$$\pi_1 = 0.058 \log \frac{p_1}{P_1}$$

The valence of the silver being one, does not enter into the formula, and since silver is an element whose solution-tension is very small, it is less than the osmotic pressure of the silver ions in the solution. Some ions will, therefore, separate from the solution upon the bar, and the solution will be negative with respect to the bar. This changes the sign of the potential, and throws the osmotic pressure in the numerator and the solution-tension in the denominator, which is exactly the reverse of what we had when the solution-tension of the metal was very great with respect to the osmotic pressure of the metal ions in the solution.

The potential between the bar of silver and the aqueous solution of silver nitrate is:

$$\pi_2 = 0.058 \log \frac{p_2}{P_2}$$

The electromotive force of the element as a whole is the difference between the potentials on the two sides:

$$\pi_1 - \pi_2 = \pi = 0.058 \left(\log \frac{p_1}{P_1} - \log \frac{p_2}{P_2} \right)$$

Making P_2, the solution-tension in the aqueous solution, $= 1$, we have:

$$\text{Log } P_1 = -\left(\frac{\pi_1 - \pi_2}{0.058} \right) + \log \frac{p_1}{p_2}$$

Inserting into this equation the values of p_1 and p_2; *i. e.*, the osmotic press-

ure of the silver ions in the alcohol and aqueous solutions, respectively; we can calculate P_1, the solution-tension of the metal in the alcoholic solution, in terms of the solution-tension in the aqueous solution as unity. The osmotic pressure of the silver ions in the aqueous solution can be readily determined from the conductivity results, being proportional to the dissociation in this solvent. The osmotic pressure of the silver ions in the alcoholic solution can be determined only approximately, since by the conductivity method, as we have seen, we can measure the dissociation of an electrolyte in alcohol only approximately. Obtaining this value as accurately as possible, and inserting in the above equation, we obtain for P_1 the value 0.05. This is in terms of water as unity, and means that the solution-tension of silver in the alcohol solution of its salt, is about one-twentieth of the solution-tension of this metal in the aqueous solution. More recent work by Jones and Smith has shown that the solution-tension of zinc in an aqueous solution of one of its salts, is very different from that in an alcoholic solution of the same concentration of the same salt. The solution-tension of the metals, then, varies from solvent to solvent.

This conception of solution-tension has been extended from the metals to other substances, until we have come to regard solution in general as due to the solution-tension of the soluble substance. In the light of this extension of the term, it is not at all surprising that the solution-tension of a metal varies from solvent to solvent, since we know that the solution-tension or solubility of chemical compounds varies greatly from solvent to solvent. We can, then, regard solution-tension as that force which drives the substance into solution in the solvent; if it is a metal or an electrolyte, the atoms passing over into ions, if a non-electrolyte the molecules dissolve as such in the solvent.

SOME WELL-KNOWN ELEMENTS.

The elements which we have thus far studied give an electromotive force which is unchanged, and are, therefore, known as *constant*. Many of the elements which are used in practice as a means of obtaining electrical energy, have an electromotive force which changes after a time, and are, therefore, known as *inconstant*. One or two of the more common elements will be considered.

The *bichromate cell* is a form of battery which finds frequent application in connection with certain kinds of work, and especially in the laboratory. The element consists of a carbon and a zinc electrode, both being immersed in a solution of potassium bichromate and sulphuric acid (chromic acid). The zinc dissolves because of its high solution-tension, and, therefore, this becomes the negative pole or the anode, the carbon being the positive pole. The ions Cr_2O_7 probably yield a few chromium ions of higher valency, which pass over into chromium ions of lower valency, and thus increase the electromotive force of the element. Since the ions Cr_2O_7 are constantly decreasing in number, and the chromium ions of lower valency, and also the zinc ions are increasing in number, the electromotive force of this element can not remain constant.

This agrees with the facts. After the bichromate cell has been used for a time its electromotive force rapidly decreases.

The action of the *Leclanché element** is a little more complex.

"The poles of this useful element are carbon, and manganese dioxide and zinc; the electrolyte, ammonium chloride. The carbon and manganese dioxide are generally mixed with one another. Zinc ions pass into solution, and, consequently, the zinc pole is the anode. The ammonium ions $\overset{+}{N}H_4$ pass over to the cathode, but the hydrogen ions, already present as the result of the dissociation of water, lose their charges more readily than ammonium, and, consequently, separate at the carbon cathode. The carbon pole would absorb a large amount of hydrogen. The MnO_2 acts as we would expect, as an oxidizing agent. This yields a few $\overset{++++}{Mn}$ ions which tend to pass over into $\overset{++}{Mn}$, by giving up part of their charge to the cathode. We have thus two actions taking place in the Leclanché element, but the electromotive force decreases because the zinc ions become more and more concentrated."

A form of battery which has recently supplanted many of the primary cells in technical work, is known as the *accumulator or secondary battery*. These have come into such general use in the last few years, that a word is necessary in reference to the action which takes place in them. Theoretically, we could make an accumulator out of any reversible cell, by simply passing a current through it in the direction opposite to the one in which the current flows when the element is closed. Practical difficulties, however, come into play in a majority of cases, so as to render most such elements useless as accumulators. In practice, the accumulator which is used consists of plates of lead, covered with lead oxide or sulphate, and immersed in a solution of sulphuric acid of a certain specific gravity. When a current is passed through this element, the pole where the current enters becomes covered with lead dioxide, while metallic lead is deposited on the opposite pole. The action of the charging current is, therefore, to convert lead sulphate or oxide into metallic lead at one pole, and into lead dioxide at the other.

If the cell is allowed to discharge, both the metallic lead at the one pole and the lead dioxide at the other, pass over into lead sulphate in the presence of the sulphuric acid. The chief source of the electromotive force of an accumulator is the passing of quadrivalent lead ions, $\overset{++++}{Pb}$, into bivalent ions, $\overset{++}{Pb}$. The quadrivalent ions, furnished by the lead dioxide, pass over into bivalent and form, with the sulphuric acid, lead sulphate. Metallic lead dissolves at the anode, forming lead ions which carry the positive electricity off from this pole into the solution. With the SO_4 ions of the sulphuric acid these ions form lead sulphate.

The action in the accumulator, on discharging, is exactly the opposite of that which takes place when it is being charged, as we would expect. Charging consists in transforming bivalent lead ions into quadrivalent; while discharging consists in the reverse transformation of quadrivalent lead ions into bivalent.

SOURCES OF THE ELECTRICAL ENERGY IN PRIMARY CELLS.

We should not conclude our study of primary cells without inquiring into the source of the energy which is converted by them into electrical energy. We know from the law of the conservation of energy that no energy is created or destroyed. Therefore, the large amount of energy which appears as electrical energy in such cells, must come from some other source of energy; the transformation being effected in the cell itself.

Take the element which we first studied in detail—the concentration element. What is the source of the electrical energy in such a cell? We have a certain amount of zinc in each electrode, and a certain amount of zinc chloride on each side of the cell. As the cell gives out electrical energy, or, as we usually say, as the cell acts, zinc dissolves on one side, and just as much zinc separates from the solution on to the bar, on the other side. The one solution of zinc chloride becomes more concentrated, and the other, by just the

*The following paragraph on the Leclanché element is taken from Elements of Physical Chemistry, by Jones, which will soon be published.

same amount, more dilute. After the cell has been closed for any length of time that we choose, the amount of zinc chloride in solution on the two sides of the cell is exactly the same as when the cell was first closed, and the amount of zinc in the two electrodes is exactly the same as at the outset. The condition of the zinc chloride and of the zinc is exactly the same, from a chemical standpoint, after the cell has been in operation as before it was closed. The chemical energy in the metal and in the solutions is, therefore, the same after the cell has been in operation as before. The electrical energy which has appeared in the cell, then, can not come from chemical energy which has disappeared as the result of action which has taken place between the constituents. Since the electrical energy which has appeared can not come from chemical energy which has disappeared (none having disappeared), it must come from some external source. Such elements have the power of taking up energy in the form of heat from external objects, and converting it into electrical energy; and this is probably the chief source of the electrical energy which appears in such cells.

In other forms of primary cells, however, chemical energy does disappear. This applies to all the more common forms of such cells, and especially to those which are capable of yielding any appreciable quantity of electrical energy. It will be remembered that the concentration elements can only furnish a very small amount of electrical energy. All primary elements which have any considerable technical value, must be capable of furnishing a considerable quantity of electricity at a fairly high potential, say about a volt. The electrical energy, as we have seen, is equal to the quantity multiplied by the potential. When the electrical energy is large some chemical or intrinsic energy must disappear.

If we study the action which takes place in any element like the Grove, Bunsen, Daniell, Leclanché, etc., we shall find that the substances which are present in the cell are in a very different condition, chemically, after the cell has been acting for a considerable time, than before such action took place. The amount of metal in one or both electrodes has changed; or metal has been deposited on one electrode and dissolved from the other; and since the electrodes are of different metals, this would represent a different amount of chemical energy in the system as a whole. And, further, the condition of things in solution has very greatly changed. There is frequently more of one metal in solution after the cell has been acting than before, and less of the other metal; and this would represent a very different condition with respect to the amount of chemical energy present in the system.

Such elements as these transform chemical energy into electrical; but there is still one question unanswered. Does the transformation take place quantitatively? That is, does all the chemical energy which disappears in such elements appear as electrical energy? And this suggests as a corollary the further question, does all the electrical energy which appears come from the chemical energy? A moment's thought will show that these two questions are not the same.

The first question has been answered by Lord Kelvin and Helmholtz, both theoretically by thermodynamics and practically by experiment. All of the chemical energy which disappears in the cell is not necessarily converted into electrical energy. Some of it may be converted into heat and escape in this form. We know of many elements which give out heat energy as well as electrical energy, and, indeed, most of the primary elements of any technical value belong to this class.

The same investigators have answered the second question. They have shown that all the electrical energy which appears in a primary cell, does not necessarily come from the chemical or intrinsic energy which disappears. A primary cell may have the power of converting, also, some heat energy into electrical energy, and the amount of electrical energy furnished by the cell may be greater than the amount of chemical energy which has disappeared in the cell. Such elements take up the heat energy from surrounding objects, and, consequently, become colder as the action of the cell proceeds. These temperature coefficients of primary cells are, however, not usually very great; the amount of heat energy generated in the one, or the amount used up in the other, being comparatively small.

We may say, then, in general, that the chief source of the electrical energy which appears in the well-known forms of primary cells, is the chemical energy of the substances present in the cell as electrodes and electrolytes. Such cells may, however, convert some of the chemical energy into heat energy which escapes, or may take up heat energy from surrounding objects and convert it into electrical energy.

CONCLUSION.

In the preceding chapters we saw how the laws of gas-pressure apply to the osmotic pressure of solutions, we traced the rise of the theory of electrolytic dissociation and made a few applications of it to chemical problems. In the subsequent chapters I have endeavored to show how these two epoch-making generalizations have been applied, especially to electrochemical problems. Light has been thrown, by means of the theory of electrolytic dissociation, on the whole subject of electrolysis and the electrolytic decomposition of substances in solution. Before this theory was proposed our knowledge was limited mainly to the facts, and such generalizations as had been reached, while they may in some cases have contained an element of truth, were entirely insufficient and unsatisfactory.

The relation between our theory and the velocities with which the ions move, is too obvious to call for any comment.

Since the conducting power of an electrolyte is due entirely to the ions which are present, new light has been thrown on this entire field by the theory of ions. Indeed, some of the most interesting applications of the conductivity of electrolytes have had to do, directly or indirectly, with the determination of the amount of dissociation of the substance which conducted the current. The relation between dissociation and dilution of the solution has always been, and is still, of more than the average interest; and the dissociating power of different solvents is a problem of great importance, about which our knowledge is, in many cases, still scarcely more than qualitative. It is obvious that all such questions have been opened up by the theory of electrolytic dissociation.

When we come to the calculation of the electromotive force of elements, we see what the two great generalizations which form the foundation of these papers, have done. This most important chapter of electrochemistry has been created since these generalizations were reached, and as the direct result of their application. We can now interpret, in terms of them, the action of the primary cell, and have an insight, for the first time, into what takes place in the battery, which was discovered by Volta more than a century ago.

These are but relatively few of the applications of these generalizations to electrochemical problems. If we were to inquire into their applications in other directions, we should find that they are just as numerous and important. The whole science of the new physical chemistry, which has grown up in the last fifteen years, centres around these generalizations; and more has been done in this period to place chemistry upon an exact mathematical basis, and to correlate it with the only exact science, physics, than was accomplished before this time in the whole history of the science. To follow any farther this line of thought would lead us beyond the scope of these paper chapters, and must be left to the student of the whole field of physical chemistry, of which electrochemistry is only a part, but an important part.

ELECTRIC RAILWAY APPARATUS.

BY ERNST J. BERG.

(Concluded.)

To illustrate more fully the characteristics of the two types of motors, the following instance is considered, although it necessarily introduces some questions slightly outside of the scope of the paper.

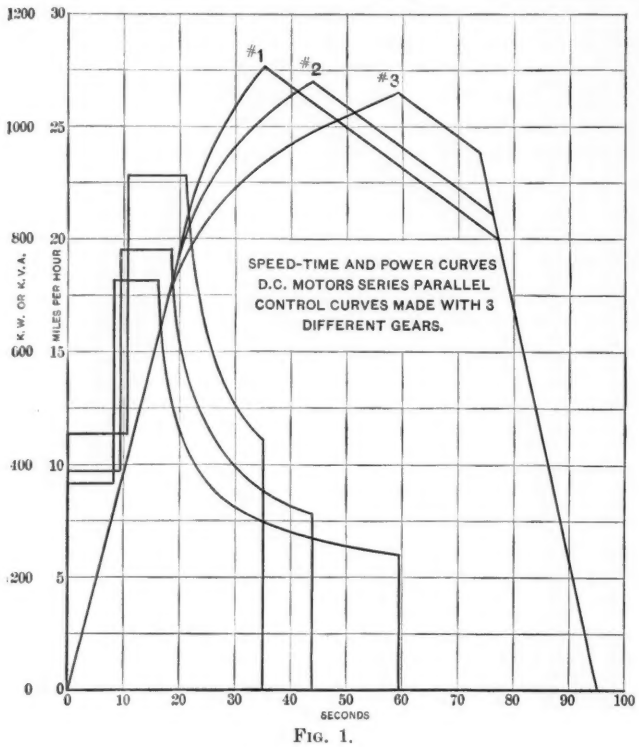


FIG. 1.

A double track road with 27 stations is supplied power from a station located a distance from the tracks. Eight trains are running in each direction, which cover the entire distance in 52 minutes.

Weight of loaded train, including locomotive, equals 180 tons (2,000 pounds).

Weight on driving wheels equals 50 tons.

Thus maximum drawbar pull at 25 per cent of weight equals 25,000 pounds.

Which corresponds to a maximum acceleration of two feet per second.

Distance of run is 2,560 feet.

Schedule speed, 15 miles per hour.

Maximum speed, 27 miles per hour.

Total distance is covered in 95.5 seconds, 20 seconds allowed for stops at each station.

No appreciable grades exist and effect of curves is negligible.

The three systems considered are:

a. The standard direct-current railway system, with series parallel control of the motors.

b. Three-phase induction motor system, with rheostatic control.

c. Three-phase induction motor system with concatenated control in accelerating as well as braking.

Obviously when running at uniform and maximum speed one system offers no advantage over any other in energy consumption, assuming same efficiency of the motors (which is very nearly the case), while the volt-amperes taken by the motors are about 20 per cent greater with the alternating-current system (running at relatively light load).

While braking, the use of either of the first-mentioned systems is immaterial, since no return of power can take place, but the third, that with concatenated control, offers some advantage in returning power, which, however, is practically offset by the large current taken, and the complication of control and design of motor.

While accelerating, however, marked differences exist in the three systems, therefore the choice of one or the other is largely dependent upon the relative time of accelerating, running at uniform speed, and braking. Since, furthermore, the power required with any particular system depends upon the method of accomplishing the run, a number of schedules have been worked out.

So, for instance, in Fig. 1 are given three runs with direct-current motors. Of these, Nos. 1 and 3 require more power than No. 2, therefore No. 2 run is referred to as the direct-current motor run in the discussion following.

In Fig. 2 are given what is considered the best alternating-current runs. One curve shows the conditions with rheostatic control, and the other with concatenated control in accelerating as well as braking. These two curves will be referred to as the alternating-current runs in the discussion following.

In Fig. 3 are given two runs with rheostatic control, both of which take more power than the corresponding run in Fig. 2, and are given merely to show that with widely different methods of running, the power does not vary more than five per cent.

In Fig. 4 are given two different runs in which concatenated control is used. These seem not so favorable as those in Fig. 2, therefore they are not referred to later except in the general table given below. The chief object of including them is to show the merits of coasting with concatenated motors. As should be expected, if the motors are connected in concatenation, when accelerating only, it is advisable to go up to as high speed as possible, and then coast without running

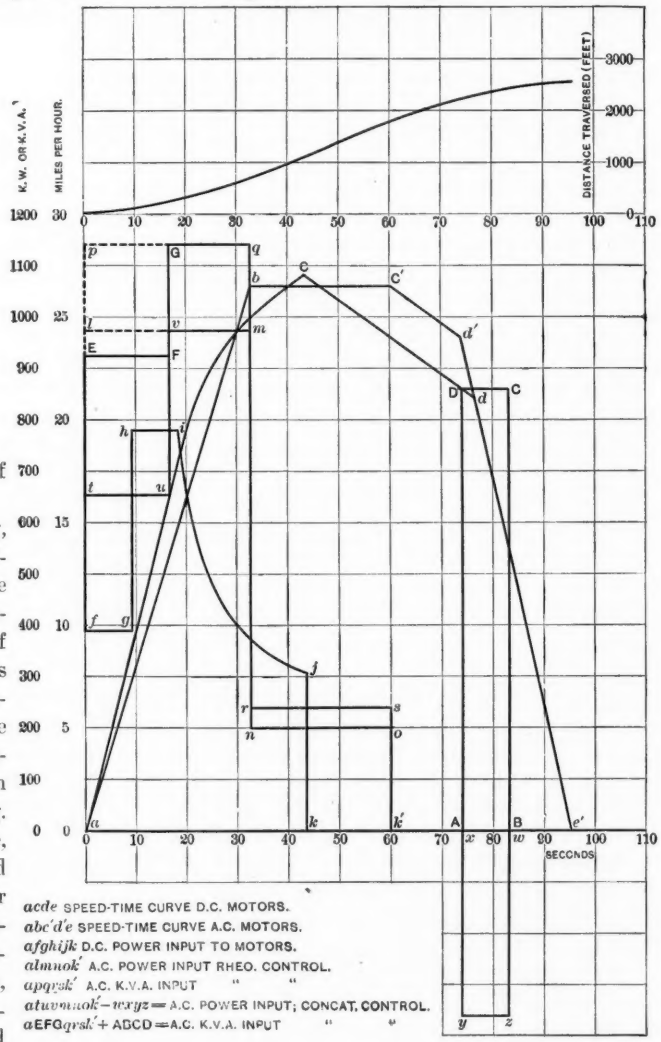

K.W. OR K.V.A.
MILES PER HOUR.
DISTANCE TRAVERSED (FEET)
SECONDS
acde SPEED-TIME CURVE D.C. MOTORS.
abc'd'e SPEED-TIME CURVE A.C. MOTORS.
afghijk D.C. POWER INPUT TO MOTORS.
almnok' A.C. POWER INPUT RHEO. CONTROL.
apqrsk' A.C. K.V.A. INPUT " "
atuvwnok'—wxyz = A.C. POWER INPUT; CONCAT. CONTROL.
aEFGqrsk'+ ABCD = A.C. K.V.A. INPUT " "

FIG. 2.

at constant speed, whereas if power is returned by concatenation it is advisable to maintain the maximum speed until time of braking.

So, for instance, the least average power taken per run is found if the cars are not permitted to coast, but accelerated and retarded in concatenation, which power is only 15 per cent more than the least direct-current power. The apparent power is, however, 2.4 times as great. In view of this very large apparent power this method is not the most favorable, but that given in Fig. 2 is preferable.

The important results of the various runs are shown in the table given below, which undoubtedly is more comprehensive than the diagrams for a superficial investigation.

Columns A, B and C are most important, and show the conditions of the best runs. Upon the constants given there and the corresponding curves the rest of the investigation is based.

Columns D and E show two direct-current runs at different gear ratios.

Columns F and G show two runs with rheostatic control only.

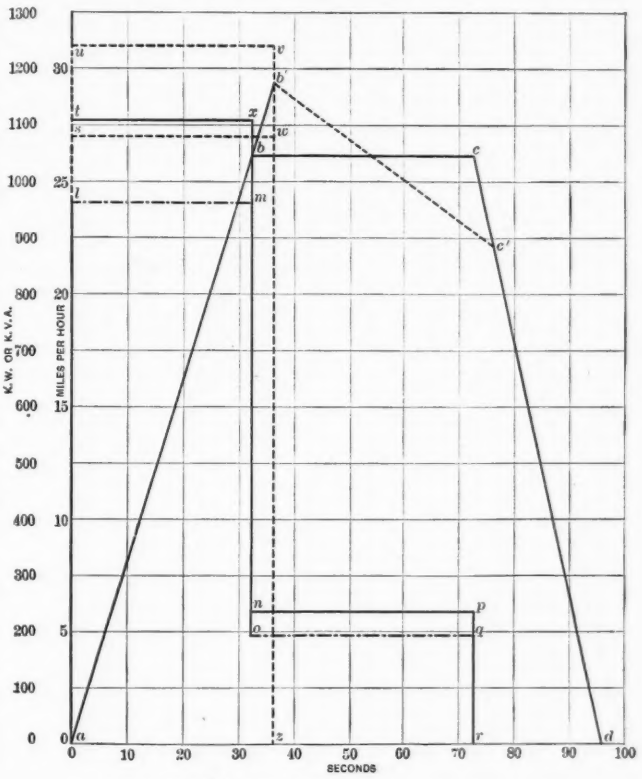
Columns H, I and J show three runs with concatenated control in accelerating only.

Columns K and L show two runs with concatenated control in braking as well as in accelerating.

In going over the matter in more detail are considered the direct-current run as shown in heavy lines in Fig. 1, and in Column A, and the alternating-current runs, with rheostatic and concatenated control as shown, Fig. 2, and Columns B and C.

gives the direct-current motor curves, Fig. 6 the alternating-current motor curves, and Fig. 7 curves of the same motors in concatenation. No special curves are given for this latter motor when used as a generator to return power, since it is essentially the same as when used as a motor.

To sum up the results, it is found from the various methods of running trains, first, that under apparently the most favorable as well as average conditions the most economical alternating-current system will take 26 per cent more power and 2.2 times as many volt-amperes as the direct-current system. Second, that the concatenated control takes 26 per cent less power but only 10 per cent more apparent power than the alternating-current system with rheostatic control. It must, however, be borne in mind that these values refer to power input at the motors, not the relations at the substations and power-house, as will be seen later.



abcd AND *a'b'c'd'*: SPEED TIME CURVE.
aswz: A.C. POWER INPUT; RHEO. CONTROL; NO RUN AT UNIFORM SPEED.
auvz: A.C. K.V.A. INPUT; RHEO. CONTROL; NO RUN AT UNIFORM SPEED.
almoqr: A.C. POWER INPUT; RHEO. CONTROL; NO COAST.
atxnpr: A.C. K.V.A. INPUT; RHEO. CONTROL; NO COAST.

FIG. 3.

	D. C. Series Paral. 33 Seconds Coast. A	A. C Rheostat 14 Seconds Coast. B	A. C. Concat 11 Seconds Coast. C	D C Motors 42 5 Seconds Coast. D	D. C. Motors 14.5 Seconds Coast. E	A. C. Rheostat 40 Seconds Coast. F	A. C. Rheostat No Coast. G	A. C.—Concat. only when Accel. 40 Seconds Coast. H	A. C.—Concat. only when Accel. 14 Seconds Coast. I	A. C.—Concat. only when Accel. No Coast. J	A. C. Concat. Brake and Accel. 40 Seconds Coast. K	A. C. Concat. Brake and Accel. No Coast. L
K. W. Seconds Accelerating	21800	31700	25100	22700	23000	39100	31100	30900	25160	22700	30900	22700
K. W. Seconds Uniform Speed	.....	5400	5400	.....	.....	.....	7800	.....	5400	78 0	.....	7800
K. W. Seconds Braking	.....	.....	—3230	.....	.....	.....	.....	.....	.....	.....	—2800	5400
Total K. W. Seconds	21800	37100	27270	22700	23000	39100	38900	30900	30500	30500	28100	25100
Average K. W. per Run	190	322	237	197	200	340	338	268	265	265	244	218
K. V. A. Seconds Accelerating	21800	37000	33600	22700	23000	44900	35800	40000	33600	32100	40000	32100
K. V. A. Seconds Uniform Speed	.....	6600	6670	.....	.....	.....	9500	.....	6600	9500	.....	9800
K. V. A. Seconds Braking	.....	.....	7730	.....	.....	.....	.....	.....	.....	.....	5400	10600
Total K. V. A. Seconds	21800	43000	47900	22700	23000	44900	45300	40000	40200	41600	45400	52200
Average K. V. A. per Run	190	379	416	197	200	390	394	348	350	362	394	454
Maximum K. W. per Run	780	977	977	912	725	1040	965	1080	977	965	1080	965
Maximum K. V. A. per Run	780	1140	1140	912	725	1240	1110	1240	1140	1110	1240	1110
Watt-Hours per Ton-mile	70	120	88	73	74	126	125	99	98	98	91	81
V. A. Hours per Ton-mile	70	138	154	73	74	145	146	129	129.5	134	146	168
Ratio $\frac{\text{Average a-c K. W.}}{\text{Average d-c K. W.}}$	.....	1.72	1.26	.....	.....	1.80	1.79	1.41	1.40	1.40	1 30	1.16
Ratio $\frac{\text{Average a-c K. V. A.}}{\text{Average d-c K. V. A.}}$	.....	1.97	2.20	.....	.....	2.07	2.09	1.85	1.85	1.92	2 09	2.40
Average P. F.	1	87	57	1	1	87	86	77	75.5	73	62	48

The characteristic curves of the motors are shown in Figs. 5, 6 and 7. Fig. 5

Power is supplied to four substations located respectively 16,600 feet, 17,400 feet, 22,800 feet and 35,000 feet from the generating station. The transmission potential is 11,500 volts.

Capacity of power-house, electrical machinery, lines, etc.—Since the supply of power is located at some distance from the receiving circuit, high-potential three-phase generators are proposed in all three cases.

(*a*) Direct-current motors with series parallel control.

Installation—The road-bed has double tracks of 85-pound rails, and the combined cross-sections of feeders and trolleys for two tracks is one square inch of copper. In the calculations all tracks and feeders are assumed interconnected, and the feeder copper strung all around the track.

The resistance of steel rails is assumed as 12 times that of the corresponding copper, and that of bonds as 50 per cent of rails. This gives the ohmic resistance of four rails in multiple between two substations (average 17,100 feet) as 0.09 ohm and the corresponding resistance of

copper as 0.159 ohm, or a total resistance of 0.25 ohm.

Each substation has three 650-kilowatt converters (one as spare) and ten 240-kilowatt transformers. The high-potential lines consist of two cables No. 00 B. & S. (one of which is spare) for each of the two distant stations and two cables No. 3 B. & S. for the two nearer stations.

Distance between substations equals 17,100 feet.

The transformers have two per cent *I. R.* loss and one per cent core loss. The converter has 94 per cent efficiency over considerable range of loads. The generating station has four 1,600-kilowatt generators (one as spare) and engines.

Referring to Fig. 8 we find that neglecting losses,

	Kilowatts
Average load in kilowatts on one substation is	760
Maximum load on one substation is	1,600
Average load on the generating station is	3,040
Maximum load on the generating station is	4,400

This brings the average actual load on a rotary converter to 832 kilowatts.

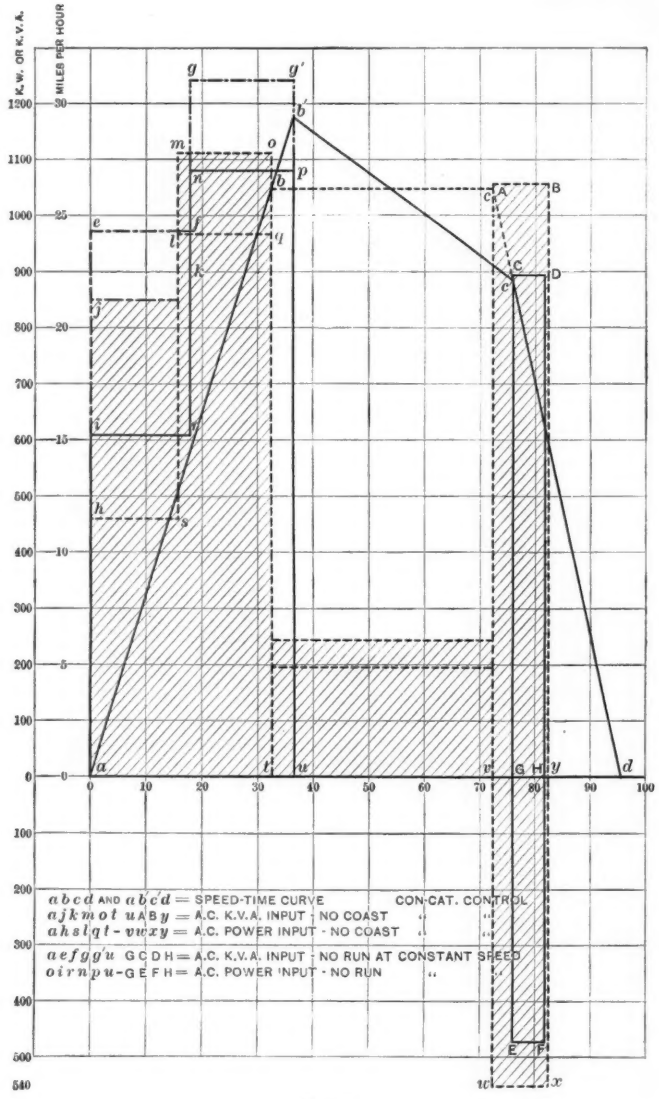

K.W. OR K.V.A.
MILES PER HOUR
abcd AND a'b'c'd' = SPEED-TIME CURVE CON-CAT. CONTROL
ajkmot uABy = A.C. K.V.A. INPUT - NO COAST
ahslqt - vwxy = A.C. POWER INPUT - NO COAST
aefgg'u GCDH = A.C. K.V.A. INPUT - NO RUN AT CONSTANT SPEED
oirnpu - GEFH = A.C. POWER INPUT - NO RUN

FIG. 4.

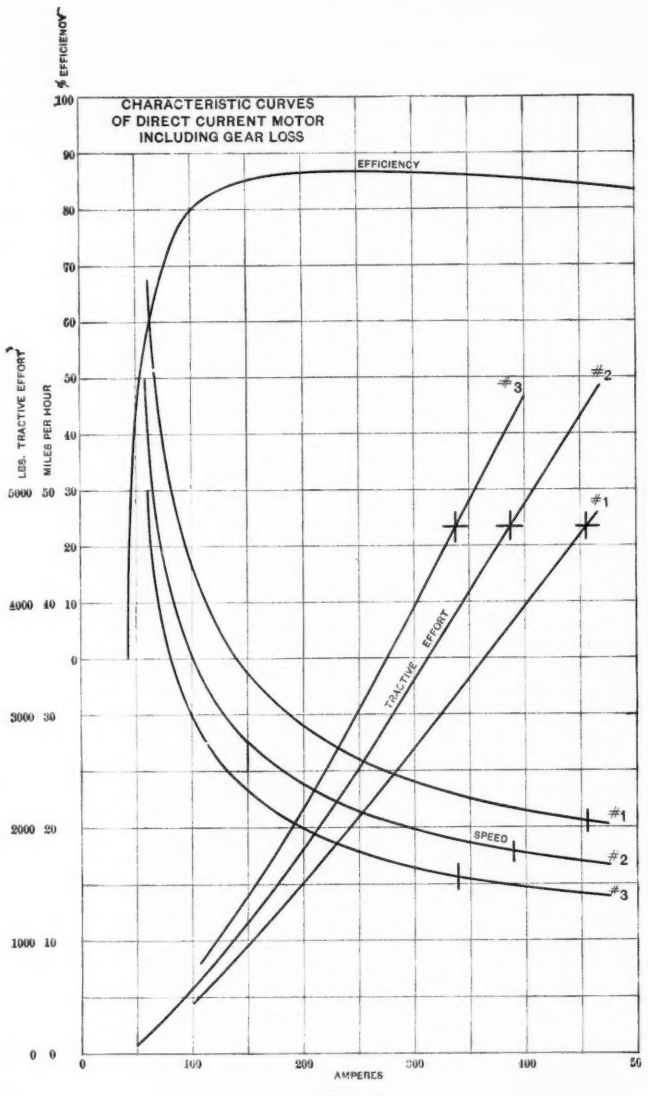


FIG. 5.

Maximum load on rotary converter.... 1,910
Average load on generating station.... 3,650
Maximum load on generating station.. 5,650

The converters run at 64 per cent load at average load; the converters run at 146 per cent load at maximum load.

The generators run at 76 per cent load at average load; the generators run at 118 per cent load at maximum load.

(*b*) *Alternating-current motors with rheostatic control*—The motors are supplied power from four substations at an average potential of 3,000 volts over two sets of three-trolley wires, No. 00 B. & S. (interconnected). Each substation has four 700-kilowatt transformers (one to spare). The high-potential lines are two sets of No. 00 B. & S. and No. 2 B. & S. respectively for the longer and shorter distances.

The generating station has five 1,800-kilowatt three-phase 11,500-volt generators and five 1,700-kilowatt steam engines.

From the load diagrams, Figs. 9 and 10, is found that neglecting losses,

	Kilowatts
Average power on substation is	1,290
Average K. V. A. on substation is	1,515
Maximum power on substation is	2,300
Maximum K. V. A. on substation is	2,800
Average power, generating station is	5,150
Average K. V. A., generating station is	6,060
Maximum power, generating station is	7,100
Maximum K. V. A., generating station is	8,300
This gives an average K. W. output of power station	5,600
This gives an average K. V. A. output of power station	6,500
This gives maximum K. W. output of power station	7,780
This gives maximum K. V. A. output of power station	8,880

The generators will run at 90 per cent load at average load; the generators will run at 123 per cent load at maximum load.

The engines will run at 92 per cent load at average load; the engines will run at 126 per cent load at maximum load.

(*c*) *Alternating-current motors, concatenated control*—The secondary network is laid out as in previous case, but the high-potential lines are duplicate sets of No. 000 B. & S. and two No. 000 B. & S. cables in multiple for the shorter and longer distances respectively.

Each of the four substations has four 800-kilowatt transformers. The power station has five 2,000-kilowatt generators and five 1,700-kilowatt engines.

From the load diagram, Figs. 11 and 12, is found that neglecting all losses,

	Kilowatts
Average power on substation is.....	948
Average K. V. A. on substation is.....	1,660
Maximum power on substation is.....	2,000
Maximum K. V. A. on substation is...	3,500
Average power on generating station is	3,800
Average K.V.A. on generating station is	6,650
Maximum power on generating station is.....	6,000
Maximum K. V. A. on generating station is.....	10,000
This gives an average K. W. output of power station.....	4,170
This gives an average K. V. A. output of power station.....	6,850
This gives a maximum K. W. output of power station.....	6,000
This gives a maximum K. V. A. output of power station.....	10,000

The generators will run at 85 per cent load at average load; the generators will run at 125 per cent load at maximum load.

The engines will run at 75 per cent load at average load; the engines will run at 107 per cent load at maximum load.

The selling prices of the various items referred to are assumed as follows:

Complete steam equipment, including installation, $75 per kilowatt.

High-potential generators, switchboards and instruments, $26 per kilowatt.

Rotary converter substations and apparatus, $40 per kilowatt.

Transformers (700 kilowatts) $4.50 per kilowatt.

Direct-current electric locomotive complete, $15,000.

Alternating-current electric locomotive complete, $19,000.

Passenger coaches (70 seats), $4,500.

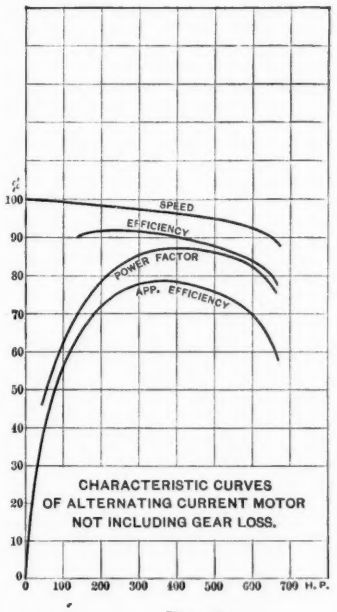


FIG. 6.

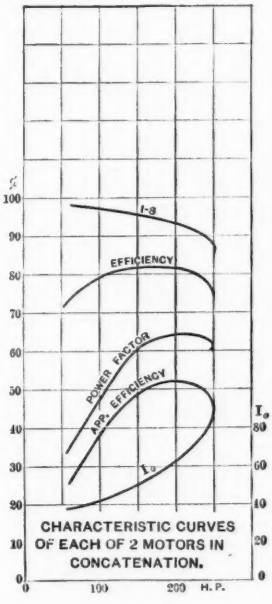


FIG. 7.

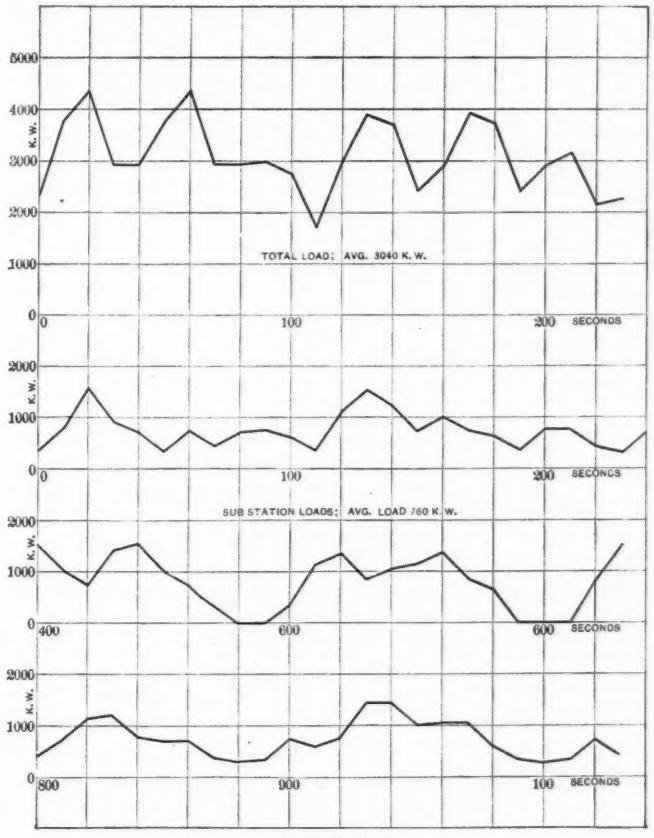


FIG. 8.

High-potential cables (10,000-volt), No. 000 B. & S., $1,060 per 1,000 feet.

High-potential cables (10,000-volt), No. 00 B. & S., $930 per 1,000 feet.

High-potential cables (10,000-volt), No. 0 B. & S., $840 per 1,000 feet.

High-potential cables (10,000-volt), No. 1 B. & S., $710 per 1,000 feet.

High-potential cables (10,000-volt) No. 2 B. & S., $650 per 1,000 feet.

High-potential cables (10,000-volt), No. 2 B. & S., $600 per 1,000 feet.

Copper, $0.186 per pound.

Direct-current trolley construction, $900 per mile.

Alternating-current trolley construction, $1,200 per mile.

Eighty-five-pound rails, per ton, $26.

Track construction, $500 per mile.

EXPENSES OF INSTALLATION AND AMOUNT POWER REQUIRED.

a. Continuous-current motors, with series parallel control.

b. Alternating-current motors, with rheostatic current.

c. Alternating-current motors, with concatenated control.

	a.	*b*.	*c*.
Power-house steam equipment	$480,000	$600,000	$525,000
Power-house electrical equipment	166,000	234,000	260,000
	$646,000	$834,000	$785,000
Rotary converter station	$312,000	....	....
	$312,000	$50,500	$57,500
Transformers	....	$50,500	$57,500
	$312,000	$50,500	$57,500
Seventeen locomotives, complete..	$225,000	$322,000	$322,000
Sixty-eight passenger coaches.....	306,000	306,000	306,000
	$531,000	$628,000	$628,000
Cables, duplicate..	$157,000	$172,000	$366,000
Trolley and feeder copper	49,000	31,000	31,000
	$206,000	$203,000	$397,000
Track construct'n.	$109,000	$109,000	$109,000
Trolley construction	23,400	31,200	31,200
	$132,400	$140,200	$140,200
Total cost..	$1,857,000	$1,856,000	$2,008,000
Average kilowatt power required.....	3,650	5,600	4,170
Kilowatt average loss.	600	440	380
Percentage loss.....	16.4	7.8	9.1
Percentage of direct-current power.....,	100	153	114

Percentage cost of direct-current installation	100	100	107

It is thus apparent in this particular instance, which is fairly representative for heavy urban work, that the direct-current system offers decided advantages in economy if installed at the same price as the alternating-current system, and that the same economy can not be obtained with alternating current, no matter at which cost; furthermore, that the alternating-current system with concatenated control is preferable to that with rheostatic control. It must, however, be borne in mind that for an actual installation, practical conditions might warrant different amount of machinery and different units, and that allowances must be made for sharp turns, grades, etc., and that the prices given are somewhat arbitrary. The three systems are, however, placed on as nearly as possible the same footing, so that the comparison should be fair, even if the actual cost of the installation is considerably different.

To conclude, it might be stated that due to the favorable characteristics of the direct-current railway motor and the rotary converters, compared with the alternating-current motor for this class of work, very few propositions warrant the use of the alternating current throughout. Indeed, there is no question that the stand taken by the American engineers in this matter in recommending rotary-converter systems almost exclusively is correct and warranted by considerations of economy and first cost, no matter what the adverse criticisms have been of late. There is undoubtedly a field for alternating-current motors, but it is strictly limited to long-distance schemes with very few stops, or to mountain roads.

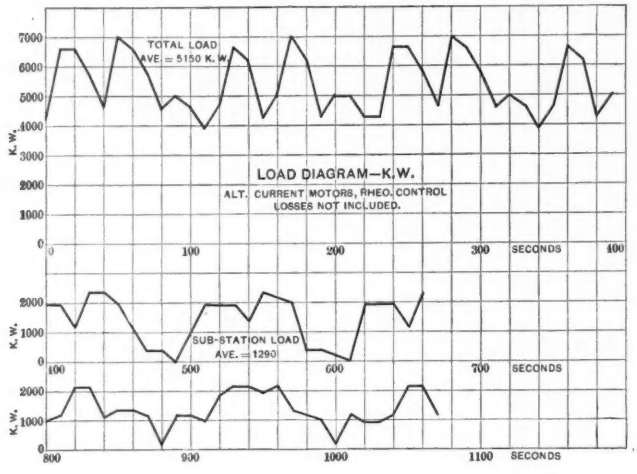


FIG. 9.

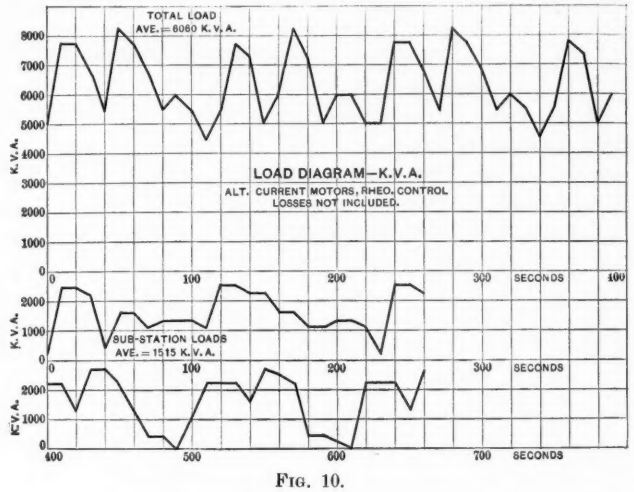


FIG. 10.

The nut-cracking industry gives employment to a considerable number of persons in St. Louis, Mo., there being three plants in the city. Electricity is used to drive the nut-crackers, each nut being fed individually into the crusher. The nuts are winnowed by an air blast after the shells have been cracked, and the meats are taken from the crushed shells by hand, women and girls being employed for this part of the work.

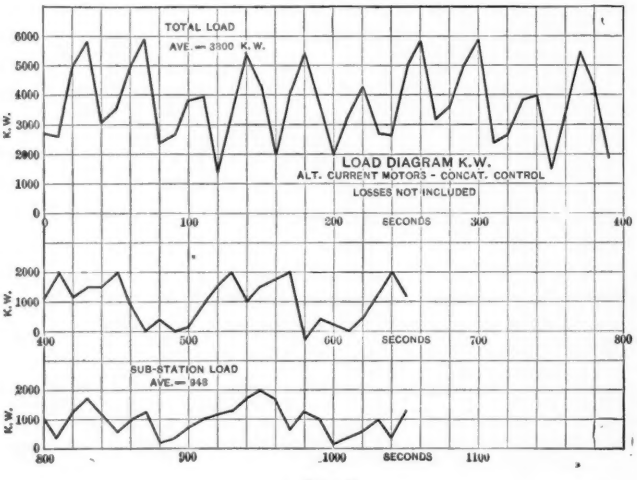


FIG. 11.

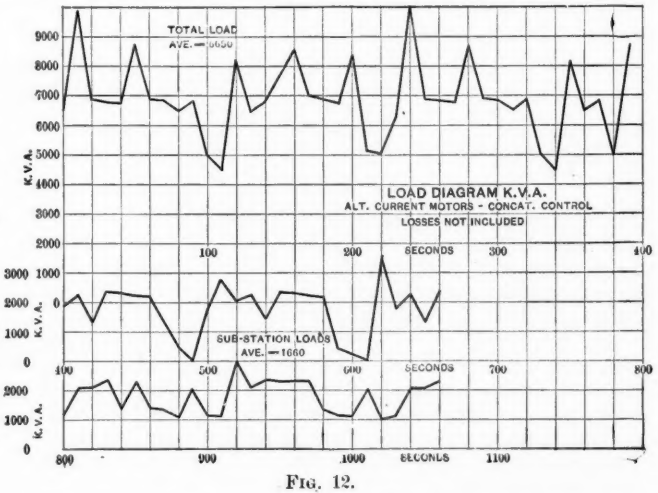


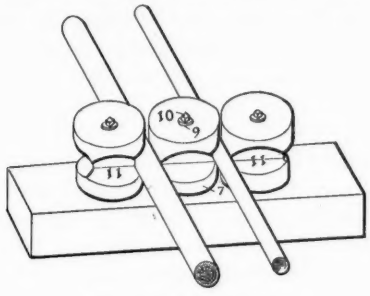
FIG. 12.

Copper Smelting in Central Asia.

During his travels through Asia, Dr. Futterer saw some of the primitive copper smelting places, which he describes in his book, says the trade journals' *Review*. Near Tschadurkul there are vast forests which are utilized by the natives for smelting copper ore obtained from the Kaschgarian Mountains. The arrangements for this process are simple. In front of a clay hut are a number of furnaces, which are connected with bellows in the interior of the hut by an earthen pipe. The furnaces are filled with ore and charcoal up to the height of the tube, and covered up with clay, only leaving a small opening for the escape of smoke. The bellows consist of skins stitched together, open at one end, and are worked with two sticks. At the back of these furnaces or smelting troughs sits a man who attends continually to two bellows. When ready, the molten mass is run out, after a part of the furnace front is broken away, and the copper separates from the slag. In places where timber is not so plentiful, roots are often dug up for fuel.

Electrical Patents

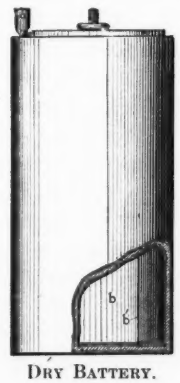
A rather novel idea in the line of insulators has been devised by Henry D. Murdock, of Pittsburgh, Pa. He provides a series of insulator blocks having transverse horizontal grooves in their opposing faces, these grooves being of different sizes to accommodate different thicknesses of wires. Each block is made of



Adjustable Insulator.

two sections, connected by a vertical bolt which also forms the means for securing the block to the support. This support is in the form of a base having a vertical slot through which are passed the holding bolts of the insulators, so that said insulators may be moved toward or from each other and thus adjusted to receive the different kinds of wire. This arrangement is exceedingly simple, and forms a rigid support which will carry several gauges of wire. As many blocks can be employed as desired, the grooves in the opposite sides forming sockets to receive the wire.

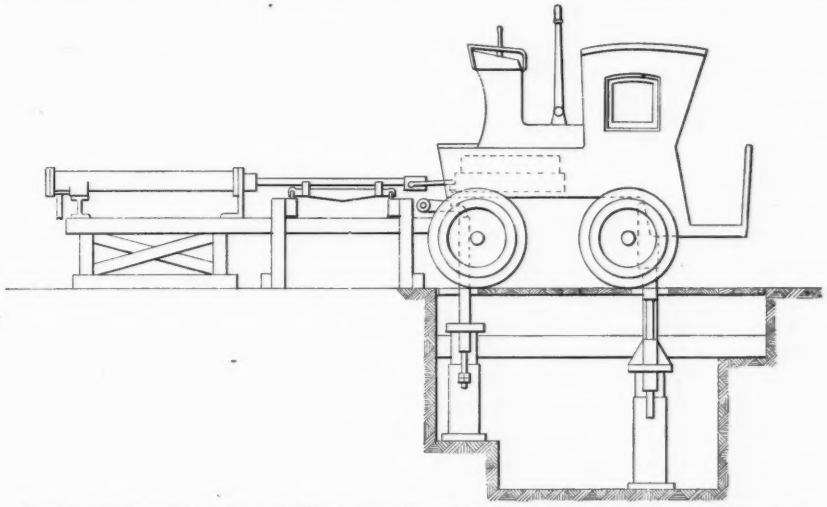
In a new dry battery devised by Henry



Dry Battery.

Splitdorf, of New York, the zinc element is slit longitudinally and is placed in a case comprising inner and outer concentric paper shells, between which is placed a packing consisting of a mixture of paraffin and resin. By this construction the electrolyte has access to the outer as well as the inner surface of the electrodes, while the packing prevents the fluid from reaching the outermost shell. The casing will, therefore, always remain dry and intact, while the life of the battery is greatly increased.

Mr. George H. Condict has patented a system and apparatus for loading and unloading storage batteries from motor vehicles. The patent has been assigned to the Electric Vehicle Company, of New York city. The object of the present invention relates to mechanical means for placing the vehicle to be loaded or unloaded in a definite predetermined position with respect to the loading apparatus, this positioning, or "centring," of the vehicle being accomplished through mechanism substantially as follows: The vehicle preferably used in connection with the system is provided with a battery box which opens at the ends and carries the batteries in a tray, removable therefrom, in a horizontal plane. Immediately adjacent to the rear end of the loading table, where the open end of the battery box upon the vehicle is located, is a transfer table which extends at right angles to the loading table and is greater in length than the width of the table and the vehicle upon it. At one or both sides of the loading table are hydraulic rams, which, when extended, engage and press latterly against the hubs of the vehicle and move both it and the table until the vehicle is in a predetermined position with respect to the transfer table. Other hydraulic rams are provided below the loading table and project upward through openings therein, and when the vehicle has been centred by the side rams the vertically moving rams are brought into action to slightly raise the vehicle until the battery box thereof is in a proper horizontal plane with respect to the transfer table. The transfer table is provided with a traveling chain or chains, upon which are secured carriers. The chains are propelled in either direction by a suitable motor, and automatic stops are provided, which are arranged to hold the chains at predetermined points. The storage batteries to be handled are contained in trays of substantially uniform size, and the carriers upon the chains are spaced to receive and hold the trays of batteries (the loads) between them. The automatic catches are so placed as to engage the chains when the tray of storage batteries is directly opposite to the battery box of the vehicle to be loaded, and conversely a set of carriers opposite to the battery box to be unloaded. A hydraulic ram is located on the side of the transfer table opposite to the battery box upon the vehicle when the latter is in position and is adapted to thrust a tray of batteries from the transfer table into the battery box on the vehicle or to draw a tray of batteries from the vehicle onto the transfer table between the carriers upon the traveling chains, which have previously been positioned to receive it. When the vehicle has been loaded the side rams are withdrawn and the elevating rams are lowered, when the vehicle is run off the table, which then automatically centres itself, ready for future use.



Apparatus for Loading and Unloading Storage Batteries from Motor Vehicles.

The Electric Arc Under Water.

It has been shown by experiment that an electric arc can be employed under water for fusing metal, says the London *Electrical Engineer*. The intense heat turns the water surrounding the arc into steam, thus forming an insulating cushion of vapor. In view of this state of things, the suggestion seems common sense that with proper apparatus the electric arc could be employed by divers for quickly cutting through large chain cables or iron plates under water.

THE RELATION OF ELECTRIC LIGHT COMPANIES TO MUNICIPALITIES FROM A LEGAL STANDPOINT.*

BY D. L. GASKILL.

In the short time that has been allotted to me for the reading of a paper before this association, it is impossible to discuss at any great length the various relations that exist between municipalities and electric lighting companies from a legal standpoint, and it is especially short for such consideration when we find that in order to consider the legal relations of these two great factors in municipal government, that it is necessary to speak of the business and public relations as well as those pertaining to a legal nature. There is scarcely an act performed by the companies that does not bring out these relations connected in some way with the municipality, both legal business and public. Our corporations being created by law with powers of action limited by our charters on the one hand, and the enactment of the legislature and municipality on the other, we find the importance and the great difficulty of cultivating such relations as will secure to each pleasant and profitable communication. When we consider the dearth or absence of just and equitable laws that would define the different relations between these two great parties and that would govern their legal relations, it is well to remember the old adage that "Rome was not built in a day." That 20 years ago the practical form of this mighty element which forms the basis of our business was still hid secluded in nature's storehouse waiting for skillful hands to unlock the door of its usefulness. As the progress of invention advanced at electrical speed, the enactment of laws to regulate the relations between the customer and producer did not keep pace at the same rate. During these years, and especially the early ones, we encountered opposition, rivalry and ignorance on the one hand, and possibly too much greed and disregards to the rights of the public on the other. This not only hindered the enactment of such laws as would justly and clearly define our relations, but created a spirit of animosity which we are now having difficulty in some cases in meeting. I do not hesitate to say that within a half century from now, and possibly sooner, when ourselves and our plants will possibly have gone out of existence or passed into wiser hands, our laws will be so framed and our relations with the public so regulated, as to meet the wants of the companies and the wishes of the people, and the troubles of to-day will exist only as history and possibly be forgotten. As you no doubt well know, the powers granted to municipalities are purely statutory; that is, they have no power to maintain relations with electric lighting companies save and except as given to them by the legislature, and the same may be said of the electric lighting companies being creatures of the law; we have no unlimited powers, save as the legislature may determine them. This being the case, the object for which we are incorporated must be stated in no uncertain terms in our charters, and from this legal foundation of our existence must emanate all the powers, express or implied, that we can exercise.

The lawyer's ready expedient of calling upon the common law from out the dusty shelves of legal lore does not avail him in fixing relations between municipalities and electric lighting companies.

For the purpose of this paper, I desire to consider these relations under four titles: franchises, contracts for lighting, private lighting, and rights of way on public streets as affecting private property.

While the legislature gave to the electric lighting companies the power to exist, or rather created them, the municipality gives us the power to exist by the franchise that it grants to us to use the public ways for carrying on our business. Necessarily compelled to use these highways in getting to our customers, the right of such use becomes very essential to the proper conduct of our business. This privilege or franchise is more than an ordinary contract, each of the parties granting and receiving the same, assuming duties not too well defined as yet, but being constantly called into question. On our part, we assume that the use of the highways shall not infringe or obstruct the public from the use for which they were intended. It is well to remember this point, for in no instance when the question of the right of the electric lighting companies of the streets for their purpose came in conflict with the use of the streets by the public for highway purposes, have the courts hesitated in ruling against the electric lighting companies. Our use for this purpose can go only as far as is necessary for our public use; that is, carrying our product to the public. We further, in accepting a franchise, agree that the rights of private property in such street shall not be disturbed or interfered with only so far as it may be necessary to serve the public by our lines. We further agree, and are compelled by statute to observe the rights of the pre-existing franchises, of which there can be none exclusively granted. And when our rights under such franchise, either by expiration of the limitation of time for which they have granted or by degree of the court because of forfeiture, have ended, to remove our lines and leave the streets in safe and suitable condition. We further agree in accepting a franchise, to give the public such safe and reasonable and uninterrupted service as the needs of its people and the state of invention and improvement of business will reasonably warrant.

The municipality on its part, in granting such franchise, is bound to protect the company in its use of the highways, and to refrain from enacting laws which will not permit the proper conduct of the business in dealing with the public, or that will prevent the corporation from carrying out the objects for which it was created.

The troubles which we have encountered in our short existence have not, as a rule, grown out of the franchises, but I would strongly advise the getting of long franchises from the municipalities, if possible, perpetual, if they are willing to grant them, as it is very inconvenient when your franchise is about expired to find you have an antagonistic municipality with the alternative of either getting the franchise or being compelled to remove your property from the public highways. Another provision which should be inserted in every franchise is to provide that accident or reasonable interruption of the service shall not abrogate the rights created thereunder. Being private corporations, assuming and taking unto ourselves public powers, we are compelled to furnish uninterrupted service under such reasonable requirements as fair management and reasonable conditions will warrant, but there have been instances where this has been taken advantage of by unfair municipalities, and franchises sought to be revoked or disregarded for want of a clear understanding of the terms of the grant.

ELECTRIC LIGHTING CONTRACTS.

In most of the cities of our state, and I would say with over 90 per cent of our companies, the municipality is the largest consumer of our product and one whose business we must have in order to earn expenses of operation. The truth of this statement is only too evident when the disease of municipal ownership begins to affect a municipality. If a business man

*Selections from a paper read before the Ohio Electric Light Association, August 22, 1901.

was entirely dependent upon the trade of one customer to enable him to operate his business in a successful way, I believe I state a commercial axiom when I say that his greatest efforts should be concentrated upon his desire to please that particular customer. The importance of having good business relations with such a customer becomes apparent at once. It is evident to all of us that there exists in every community a spirit of animosity and hostility toward public service corporations. Sometimes this spirit is latent and we are enabled, by careful dealing, to keep it at the minimum, but sometimes it is active, and when the latter is the case, I believe you will agree with me that the troubles of the electric lighting manager increase and multiply at a very rapid rate. I am not sure but that in some instances companies are, in a measure, responsible for this feeling. Frequent disregard of the spirit and terms of the contract, neglect to rectify mistakes and to pay close attention to complaints, usurping privileges which the franchise does not grant, and failure sometimes to realize the public nature of our business, are some of the things that tend to engender and increase this spirit of hostility toward our corporations and destroy public confidence in our business. It may be said that these troubles arising are business rather than legal, but the dividing line between these relations is so close and indistinct, that in the test of legal relation or rights it will be found that the performance of duties incumbent upon us from business relations will go far to establish our legal position. A well-performed contract is generally a good contract, and when a court of equity is called upon to interpret and weigh the differences between the municipality and the electric lighting company, the one whose hands are whitest, from an equitable stantpoint, will have the advantage in the determination of the issues.

Disregard of complaints, unequal charges, interrupted and poor service, are handicaps in pleading for favors at the hand of a just and unbiased tribunal. Do not understand me that I am criticising our companies in allowing the municipality to go free from complaints, but these duties on the part of the companies go so far to regulate the relations of these parties and enter so largely into the legal determination of their rights that I deem it is proper that we should understand our duties clearly and be in position to put the municipality in the blame, should such occasion arise.

Municipalities, on their part, have, no doubt, more often sinned than have the companies. If we could deal with the same parties at the termination or during the existence of our contracts that we do when we make them, we would have less trouble, but, as a rule, the governing bodies change. Men who know nothing of the terms of the contract save and except what they may have carelessly read from time to time, undertake to interpret and regulate the duties of the city in relation to the company upon these contracts, and I believe that it is the experience of every company here that municipalities, as a rule, endeavor to over-reach the terms of the contract and exact greater requirements after the contract has continued in force for some time, than they do at the start. The worst trouble that we experienced during our existence in meeting the wishes of the municipal bodies is the disregard of the public in the property rights of the electric lighting company. The building of a plant in a city where the city's business is necessary for its existence, creates a moral right upon the municipality either to patronize such company, or, if it decides to enter into the business of lighting itself, purchase that plant at its reasonably fair worth. I am sorry to say that this moral right has not as yet been fully developed in the minds of our governing bodies.

The legislature will some day pass a law which will require this purchase at a fair valuation, but as yet we are compelled to be at the mercy of the public in this regard and have absolutely no redress should we be unable to influence public opinion in our direction sufficiently to counteract the desire of municipal ownership. Our position, when the city breaks over the terms of the contract, is not a comfortable one. While we may appeal to the courts for protection, and the city may be compelled to carry out the legal terms of its contract, it is not only expensive for us to do so, but it intensifies and engenders this feeling of public hostility which is so detrimental in conducting an electric lighting corporation. The terms of the contracts with the municipalities should be clear and should specifically define those points which are most likely to arise in controversy later. The definition of the number of watts to be furnished per lamp, the right to repair in reasonable time in case of stoppage or accident, the defining of the authority of the city in locating poles and lamps, and providing for compensation after once located and then changed by the city, the regulation of the prices to be charged the public for lighting, the provision for the purchase by the city in case the city desires to make such purchase, the provision of how long and how often street lights are to be operated, and the provision giving the company power to change systems and make such changes in lines as are required to meet the wants of such systems—all these and more should be clearly defined, leaving no loophole for misunderstanding or trouble.

PRIVATE LIGHTING.

It is unnecessary to say much in regard to private lighting save and except that the requirements as to uninterrupted service are good with private as well as public lighting. As a rule, the demands as made by your customers will fix the conduct of the company in this regard and as a company furnishes good service or poor service, so will its receipts increase or diminish. The prices of private lighting can, of course, not exceed the maxium as laid down in the agreement of the city, and I believe in the majority of cases the prices are considerably below that fixed by our contracts.

The use of public ways by the companies has of late been much brought into controversy largely through the telephone companies.

I do not know by what mental reasoning managers of telephone companies arrive at their conclusions on the right to use public ways, but if the situation in other parts of the state exists as it does in the part from whence I come, the troubles that the electric lighting companies are to have in the future have been largely brought about by the total disregard of the rights of both public and private property in the erecting of the lines of the telephone companies. This usurpation of power has brought several decisions of late governing the use of streets for such purposes. The electric lighting companies come into conflict with it most frequently upon trimming trees, and it is wonderful the tenacity of the property owner and his great love which he manifests toward the trees in front of his premises when an electric lighting company comes in sight with the intention of erecting a line along his premises. Dead limbs become objects of adoration, and unsightly trees beings of worship. Of late there has been some decisions against telephone companies in this regard, but the trend of authorities can be summed up that where it is necessary to trim trees reasonably for the purpose of conveying wires for the conducting of electricity, the company has a right so to do. As to how far it is necessary is, of course, a question of fact which it would require a jury to determine, but

the trend of authorities is in favor of the companies in this regard.

Under the head of franchises I stated the conditions that are required on the part of the company to be performed in using the public highways. In so doing it is always well to remember that the public have rights which the companies must recognize, and that when the use of streets for highway purposes is interfered with by the company, the courts will not sustain the company in such use. In exercising the powers that are granted to us by law, both legislative and municipal, we should remember these fundamental points, that our powers to get from our charters and all other powers that we exercise are either expressed in these charters or implied as being incidental to corporate existence or necessary and proper in order to exercise the powers expressly conferred. An example of this can be found on the right to make ways for our lines, as in trimming trees, etc., as I stated. The right to purchase land for purposes of extension, the right to loan money from the sinking fund until it is needed for the purposes for which it was created, the right to make any contract that is reasonably necessary or proper for carrying out the powers expressly or impliedly confirmed by our charters.

There are some things that we can not do. Among these, we have no power to subscribe and hold stock in another corporation, but we may in good faith take and hold such stock as a pledge or collateral for a loan or debt. We have generally no power to take our own stock either for re-selling it or for the purpose of retiring it, although we may hold it as collateral for a loan from a debt of a stockholder. The presumption is always that the contracts of a company are within its powers, and the burden of proof is on the party attacking to show that they are not. I trust that before many meetings of this association shall take place that we may have a better definition of the relations between municipality and electric lighting companies from the hand of our legislature. We need laws governing municipal ownership, governing powers of both city and companies for making contracts for public lighting, regulating use of highways and defining clearly the business regulations between municipalities and the companies, and I believe I speak truly when I say that this association is the all-important body that must look after the companies' interests in bringing about these conditions. There never was a time when it was so necessary to present a united front and good organization to meet the legal requirements and enactments that will be up for consideration in the next 10 years. There is a need of the revision of our municipal laws in all things, and something looking to that end will be passed soon. People with all kinds of fads, fancies and theories are waiting to present their claims and asking their enactment, and if they should succeed our way already hard will be made harder, while if we present our needs in an intelligent manner and appeal to the good business judgment of our legislature pointing out the errors of the fads and theories that are presented, we stand an even chance at least of bettering our relations with our best customer, the municipality.

Electrophone in England.

The popularity of the electrophone in England is increasing. The London Electrophone Company has recently reduced its rates and now it will be possible for one to enjoy unlimited supplies of music, speeches and so forth, for less than four cents per day. The company intends to reduce its tariff from its present rate of $50 to $12 per annum, and there will be no extra charges for installing the system into a private house, or for maintenance. The company has recently introduced several new devices in the apparatus which considerably improves it. One of the most important is a loud-sounding receiver. With this device it is only necessary to turn the switch, and every one within the room in which the receiver is installed is able to hear. The instrument is already connected with the Grand Opera House, leading amusement halls and churches in the metropolis. The company also proposes to introduce a traveling telephone, applicable to railway carriages.

FIG. 1.—SYNCHRONISM INDICATOR INSTALLED AT NIAGARA FALLS.

SYNCHRONISM AND FREQUENCY INDICATION—I.*

BY PAUL M. LINCOLN.

I—SYNCHRONISM INDICATOR.

It has long been recognized that the operation of paralleling alternators makes desirable the use of some more sensitive method than the usual synchronizing lamps so extensively employed in the past, and which are to-day most generally used for indicating synchronism. The obvious lack of sensitiveness on the part of lamps, when used for synchronizing, has led in many cases to the substitution of voltmeters, with a considerable improvement in the accuracy of the indications. There is still, however, much to be desired on the score of sensitiveness in indicating the point of synchronism, and this point is one which is becoming more and more important as the size of alternators become larger and their regulation stiffer.

The synchronism indicator described in the following pages is new, so far as the writer is aware, and he trusts that its analysis may be of interest to the members of the institute.

Suppose a stationary coil F has suspended within it a coil A, free to move about an axis in the planes of both coils and including a diameter of each. If an alternating current be passed through both coils, A will take up a position with its plane parallel to F. If now the currents in A and F be reversed with respect to each other, coil A will take up a position 180 degrees from its former position. Reversal of the relative directions of currents in A and F is equivalent to changing their phase relations by 180 degrees, and therefore this change of 180 degrees in phase relations is followed by a corresponding change of 180 degrees in their mechanical relations. Suppose now that instead of reversing the relative direction of currents in A and F, the change in phase relations between them be made gradually and without disturbing the current strength in either coil. It is evident that when the phase difference between A and F reaches 90 degrees the force between A and F will become reduced to zero and a movable sys-

* Paper read before the Annual Convention of the American Institute of Electrical Engineers, Buffalo, August 21, 1901.

tem, of which A may be made a part, is in condition to take up any position demanded by any other force. Let a second member of this movable system consist of coil B, which may be fastened rigidly to coil A, with its plane 90 degrees from that of coil A, and the axis of A passing through a diameter of B. Further, suppose a current to circulate through B, whose difference in phase relative to that in A, is always 90 degrees. It is evident under these conditions that when the difference in phase between A and F is 90 degrees, the movable system will take up a position such that B is parallel to F, because the force between A and F is zero, and the force between B and F is a maximum; similarly when the difference in phase between B and F is 90 degrees, A will be parallel to F. That is, beginning with a phase difference between A and F of 0, a phase change of 90 degrees will be followed by a mechanical change in the movable system of 90 degrees, and each successive change of 90 degrees in phase will be followed by a corresponding mechanical change of 90 degrees. To investigate the mechanical relations corresponding to intermediate phase relations, suppose the phase difference between A and F to be 0. The force between A and F will then be a maximum, and that between B and F, 0. Now suppose a small change in phase between A and F to take place. The force between A and F becomes slightly less than the maximum, and that between B and F becomes other than 0. The movable system will take up the position of equilibrium between forces on A and B, which will be somewhat intermediate between A parallel to F, and B parallel to F. It is further evident that the direction of motion of the movable system depends upon the sign of the differential change, so that such a device is not only responsive to a change of phase between A and F, but is also responsive to the direction of that change.

It may be interesting to note that quadrature between A and B is not absolutely necessary either in the mechanical angle between A and B, or in the phase angle between their currents. So long as there is a displacement between A and B, both mechanical and electrical, the device is responsive to phase changes between A and F.

The above is a brief description of the principles upon which rests this new synchronism indicator. Connect coil F to a set of bus-bars, and coils A and B to a dynamo that is to be paralleled to those bus-bars, and in the motion of movable coils there is a constant index of the phase condition of the dynamo with respect to the bus-bars. Fig. 1 shows a photograph of a synchronism indicator built on the above principles and installed in the power-house of the Niagara Falls Power Company, where it has been in successful operation for some time. This instrument is mounted on a swivel so that it can be made to face any one of the dynamos to be synchronized by its use. This mounting makes it possible for the attendant handling the paralleling switch, as well as the one who controls the speed of the dynamo, to see the instrument, and be fully informed as to the condition of the dynamo with respect to synchronism.

In the construction of the device shown in Fig. 1, a laminated-iron magnetic circuit is used and the phase difference between A and B is secured by using a non-inductive resistance in series with one coil, and an inductance in series with the other.

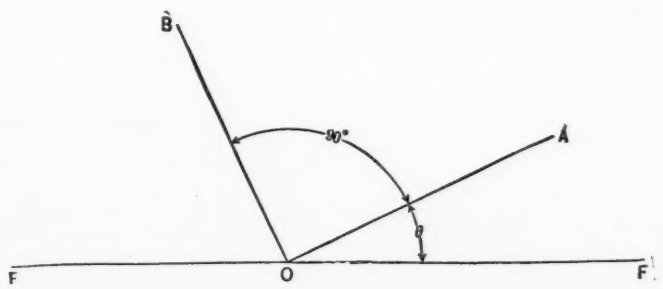


FIG. 2.

It is, of course, impossible to secure 90 degrees phase difference in this manner, but sufficient difference can be obtained to answer all practical purposes. Current is introduced into the armature through three slip rings, one of the rings being made to do duty for one end of both armature windings.

The ideal synchronizing device should perform three functions:

1. It should tell the amount of difference in frequency.

2. It should tell whether the machine being synchronized is running too fast or too slow.

3. It should tell the exact point of synchronism.

Comparing the above described device with devices now ordinarily in use for the purpose of synchronizing, in regard to these criteria, we find:

1. In regard to the first point, no difference obtains.

2. In regard to the second point, the new device gives complete information, while ordinary devices give none.

3. In regard to the third and most vital point, usual devices give only partial information, while that given by the new device is complete not only at the point of synchronism, but at every other point in the cycle.

The experience of the Niagara Falls Power Company with this new synchronizer has been most gratifying. The average time required to synchronize a dynamo has been divided by at least two, and the incipient welding of switch contacts which occasionally occurred with the old method of synchronizing, due to dynamos going in slightly out of step, has been entirely obviated. The switchboard attendant seems to feel, when synchronizing a dynamo, a degree of confidence which was impossible under former conditions.

It may be of interest to derive an expression giving at all points in the cycle the exact relations between mechanical and phase angles in such a device as is above described. It will also be of interest to determine the behavior of the device when the electrical and mechanical angles between A and B are other than 90 degrees and other conditions to be mentioned later.

In Fig. 2 let FF be the plane of the field, OA the plane of armature coil, A and OB the plane of armature coil B. In the discussion hereafter θ will always represent the mechanical angle between FF and OA and φ will always represent the electrical angle between their currents.

We shall assume:

1. That the electrical angle between the currents in OA and OB is 90 degrees.

2. That the mechanical angle between windings of A and B is 90 degrees.

3. That the ampere turns in A and B are equal.

4. That the current in armature element A is in phase with its electro-motive force.

5. That the electro-motive force produced in the armature windings by the field and *vice versa* is negligible.

6. That the electro-motive-force wave produced by the rotation of the armature in the field is a sine wave.

7. That the waves impressed upon the device are sine waves.

With these assumptions we have force on A as,

(1) $F_1 = K \sin\theta \cos\varphi$, and the force on B is

(2) $F_2 = K \sin(\theta + 90°) \cos(\varphi \pm 90°)$, whence

(3) $F_2 = \pm K \cos\theta \sin\varphi$.

For equilibrium $F_1 + F_2 = 0$, whence

(4) $\sin\theta \cos\varphi = \cos\theta \sin\varphi$

(5) $\tan\theta = \pm \tan\varphi$

(6) $\theta = \pm\varphi$ or $\pm(\varphi + 180°)$

The double signs indicate that the direction of rotation of θ with respect to φ depends upon the sine of the angle between the two armature currents. The two values 180 degrees apart indicate two points of equilibrium in the cycle. One of these is evidently a point of unstable equilibrium.

If now the electrical angle between the two armature windings is other than 90 degrees, the above will be modified as follows,

Force on A is:

(7) $F_1 = K \sin\theta \cos\varphi$

and force on B is:

(8) $F_2 = K \sin(\theta + 90°) \cos(\varphi \pm \beta)$

Where β is the electrical angle between the currents in the two armature windings.

For equilibrium:

(9) $\tan\theta = \pm \sin\beta \tan\varphi - \cos\beta$

From this it is seen that when $\varphi = \pm 90°$, and when $\varphi = 0°$ or $180°$, $\theta = \beta - 90°$ approximately, that is, so long as β does not depart largelv from 90 degrees. It is also evident that the maximum difference between θ and φ occurs close to the point $\varphi = 0°$ or $180°$.

Under these conditions, therefore, the maximum departure from equality between θ and φ occurs when φ is nearly zero and amounts practically to the amount the electrical angle between the two armature currents departs from 90 degrees.

Differentiating (9) we get:

(10) $$\frac{d\theta}{d\varphi} = \pm \sin\beta \frac{\cos^2\theta}{\cos^2\varphi} = \frac{\cos^2\theta \cos^2\beta \pm 2 \sin\theta \cos\theta \cos\beta + 1}{\sin\beta}$$

Which is an expression for the sensitiveness of the device. That is, if the electrical angle is varying at a constant rate, the above expression gives the rate at which the mechanical angle varies. An inspection of the above expression shows that supersensitive and hypersensitive points exist on diameters at about the points $\theta = \pm 45°$.

The exact points of supersensitiveness and hypersensitiveness are

(11) $$\theta = \tan^{-1} \frac{\cos\beta}{2} \pm \sqrt{1 + \frac{\cos^2\beta}{4}}$$

The effect of these supersensitive and hypersensitive points is to cause an acceleration and retardation of the synchronizer indicator hand at certain points in the phase cycle even when the phase change is taking place at a perfectly even rate.

If desired, however, this variation due to departure of electrical angle from 90 degrees may be completely compensated for by adjusting the mechanical angle between the two armature windings so that it is equal to the supplement of the electrical angle between their currents. Proof of this is as follows:

Force on armature winding A is

$$F_1 = K \sin\theta \cos\varphi$$

and force on armature winding B is

$$F_2 = K \sin(\theta + a) \cos(\theta \pm \beta)$$

Where a is the mechanical angle between the two armature windings and β is the electrical angle between their currents.

For equilibrium

(12) $\sin\theta \cos\varphi = -\sin(\theta + a) \cos(\varphi \pm \beta)$

For purpose of simplifying take $\theta_1 = \theta + a$.

Substituting and expanding we have

(13) $\sin\theta_1 \cos a \cos\varphi - \cos\theta_1 \sin a \cos\varphi = -\sin\theta_1 \cos\varphi \cos\beta \pm \sin\theta_1 \sin\varphi \sin\beta$

By making $a = 180° - \beta$, this becomes

(14) $\cos\theta_1 \cos\varphi = \pm \sin\theta_1 \sin\varphi$ whence

(15) $\theta = \pm(\varphi + a \pm 90°)$

From this it appears that the difference between the mechanical and electrical angles is always a constant when the mechanical angle between the two armature currents is made equal to the supplement of the electrical angle between their currents, provided the ampere turns in the two armature elements are equal.

Now to consider the result of making one of the armature windings stronger than the other. Supposing other conditions to remain as per our assumptions we have force on winding A is

(16) $F_1 = K_1 \sin\theta \cos\varphi$

and force on B is:

(17) $F_2 = K_2 \cos\theta \sin\varphi$

When equilibrium exists:

(18) $K_1 \sin\theta \cos\varphi = K_2 \cos\theta \sin\varphi$

(19) $$\tan\theta = \frac{K_2}{K_1} \tan\varphi$$

Whence

(20) $$\frac{d\theta}{d\varphi} = \frac{K_1}{K_2} \sin^2\theta + \frac{K_2}{K_1} \cos^2\theta$$

From this it appears that at and near the diameter 0°–180° the device is supersensitive, and hypersensitive at and near the diameter + 90° to − 90°, when $K_2 > K_1$.

If $K_1 > K_2$ the supersensitive and hypersensitive points are reversed. It is further evident that supersensitive and hypersensitive points may be made to occur at any desired point in the cycle by a combination of the methods above cited.

For the purpose of a synchronism indicator it is usually preferable to dispense with any supersensitiveness at the point of synchronism for the reason that supersensitiveness at any point tends to give the indicating hand a jerky motion, setting up vibration of the armature across the point of equilibrium.

II—FREQUENCY INDICATOR.

The problem of frequency measurement is one which has from time to time attracted the attention of experimenters and designers, as a result of which a number of different devices have been proposed and tried with more or less success. My excuse for adding one more to the number of devices proposed for this purpose is that the device herein described not only gives a beautiful theoretical solution of the problem, but also bears out its promise in actual practice so far as it has been tried.

It may seem somewhat peculiar to describe in a single paper two so dissimilar devices as a synchronism indicator and a frequency indicator. The reason for this is that the two devices were conceived and developed almost simultaneously and are very similar to each other in principle and design. One was, in fact, a direct development of the other.

The synchronism indicator described in the first part of this paper is in reality a phase meter, in that it gives a continual indication of the phase relations between the currents in its field and armature. If now the current in one of these elements can be made to change its phase with reference to that in the other, due to a change in frequency, the device will evidently become a frequency indicator.

The International Engineering Congress at Glasgow.

By Our Special Correspondent.

THE exhibition at Glasgow has been instrumental in attracting many bodies to the banks of the Clyde this year, but a culminating point may be said to have been reached in the International Engineering Congress which took place on September 3, 4 and 5. Comprising no less than 27 scientific and industrial societies, no larger gathering of its kind has as yet been seen in the United Kingdom. The Glasgow University was kindly lent for the meetings, and some 3,000 members, including 200 foreign delegates, attended. The congress was divided into nine sections and the acting president of the whole was Mr. James Mansergh, who is also president of the Institution of Civil Engineers. Lord Kelvin was honorary president. The nine sections were as follows, and each had a separate president. 1. Railways. 2. Waterways and maritime works. 3. Mechanical. 4. Naval architecture and marine engineering. 5. Iron and steel. 6. Mining. 7. Municipal. 8. Gas. 9. Electrical. In the following account, only the chief electrical papers are dealt with.

Mr. James Mansergh, the president, having received the chief foreign delegates and honorary members in the Bute Hall, delivered his presidential address. In this he remarked that engineers were something more than a profession; they were a "race," and this he followed up by the significant statement that the real engineer left as little as possible to chance and did not rely upon his best mathematics any further than he could see them. An alarm had been raised that the inhabitants of the United Kingdom had touched their high-water mark in respect to the prosperity derivable from those manufacturing industries which were based upon engineering. This might be so, but the momentous question was whether we should maintain our ground. He feared that only too good a case could be made out for the allegation that a mistaken statutory system in the United Kingdom had—for the time being—discouraged the naturalization and development of electrical engineering on the largest scale. So far, the work had been done by "sample"—every specimen differing from another. Meanwhile Americans and Europeans were forging ahead fast, and we should probably have to take other people's electrical plants for some time. He remarked upon how much of the real essence of economical engineering was contained in the work of settling standards in connection with important constructive materials.

Section IX, Electrical—Mr. W. E. Langdon, who is president of this section, opened the proceedings with an address, in which he early on tackled the question of foreign competition in electrical manufactures. There were grave reasons to fear that in some paths, and notably in the development of electricity, we had not retained that prominent position so characteristic of Great Britain now for a long period. After giving some figures supporting the argument that our present production of electrical machinery for some reasons appeared to fail to meet home demands, he quoted two important factors which attended successful competition in manufacture; *viz.*, cost and promptitude of delivery. The former depended upon labor conditions, and until the employé recognized that his employer's interest was also his own, the labor regulations which had been fruitful of so much harm hitherto, and which must in the end prove disastrous to the workman, would continue. The industrial progress of the world was speedily approaching a condition that would not merely test to the utmost our skill and our means of production, but our position as a nation. It behooves us to consider what was the relation from manufacturing industry to that of our competitors and to discover whether the conditions of production were such as to give our rivals an initial advantage. We saw other countries prepared and preparing to take advantage of every new development; we saw vast sums of money embarked in the use and advancement of electricity, and we saw that England was indebted to a foreign source for a great portion of her wants. If England was to maintain her rank as a nation, the cause for all this must be ascertained and removed ere it was too late.

This address was followed by a paper entitled "Electrical Exhibits in the Exhibition," by Mr. W. B. Sayers, and the business of this section for the day concluded with an organized inspection of the exhibits mentioned in Mr. Sayers's paper.

Section I, Railways—President, Sir Benjamin Baker. Professor C. A. Carus-Wilson contributed an interesting paper entitled "The Economy of Electricity as a Motive Power on Railways at Present Driven by Steam." It is not the first time that the author has expounded views upon this subject, and, as usual, he dilated upon the unremunerative character of branch lines, which, in the near future, would probably be more so on account of the competition due to electric tramways. With steam traction it was necessary to make up very lengthy trains on branch lines where the traffic was small. This necessitated infrequency of service, and infrequency was a forerunner to unpunctuality. He gave many figures in support of his case and concluded by saying that the use of electricity on branch lines was certainly worthy of serious thought as a means of such lines yielding a more substantial proportion of the total profits.

Section III, Mechanical — President, Mr. W. H. Mead. Two papers of electrical interest were submitted to this section. One, by the Hon. C. A. Parsons and Mr. G. Gerald Stoney on "Trials of Steam Turbines for Driving Dynamos," merely recapitulated the history of the subject, and the remainder of the communication was a mass of valuable figures which emphasized the good work which is being accomplished by Mr. Parsons.

The other paper was by Mr. Gisbert Kapp on "The Rating and Testing of Electrical Machinery." In this the author's standpoint was that the rating of electrical machinery must always be influenced by the condition of its use. A tramway motor, for instance, rated by the manufacturer at a certain horse-power, would only occasionally develop that power. A similar machine for workshop use would have to be differently rated, as under these different conditions there was great danger of overheating. The question of efficiency, too, he said, was a great source of conflict between buyer and seller, especially in direct-coupled generators. The methods for ascertaining the separate efficiencies should be simple and inexpensive, and, in this connection, a worthy reference was made to the German Association of Electrical Engineers, which in 1900 appointed a committee to investigate this important matter, and which has this year provisionally adopted the report presented by this committee. Mr. Kapp

concluded by informing his hearers that the final adoption of this report has been postponed until the value of the recommendations has been proved by actual experience with them.

Section IX, Electrical — Herr O. Lasche, of Berlin, was the hero of this section to-day, with his paper on "High-Speed Railways." He described the constructional details of the three-phase high-speed military railway from Berlin to Zossen, which the Allgemeine Elektricitäts Gesellschaft, of Berlin, has constructed. He hoped that the experimental trials would form a basis for the calculation of working expenses for electric main lines, as well as furnishing engineering data as to output of motors for various speeds, etc. The whole of the propelling machinery on the car is arranged in a separate compartment in the middle, and this, together with the transformers which take the 10,000-volt current, is separated from the passenger compartments by air-shafts with double iron walls. Mechanical transmission is the means adopted for controlling the car from the driver's platform, which is in a separate compartment containing no high-pressure connections. A new and ingenious device in the shape of couplings and bearings has been introduced in order to relieve the axles of some of the weight of the motors, and after many experiments a liquid starting device has been adopted, the invention of Herr Lasche himself. Other serious problems encountered and so far satisfactorily solved have been in connection with shape of the trolleys. In fact the method of the collection of the current has been one of the most serious difficulties. The car is equipped with eight motors designed for a normal output of 250 horse-power and a *maximum* output of 750 horse-power at a speed of 950 revolutions per minute. The current is taken into the transformers at between 10,000 and 12,000 volts and reduced to something like 450 volts on the motors. A satisfactory feature of the experiment is that the German Military Railway Board are taking an active interest in the trials and have placed the line at the disposal of the German Association for the study of electrical high-speed lines for the purpose of ascertaining the extent of their practical utility. In the construction of the present car a maximum speed of 200 kilometres per hour has been assumed, but Herr Lasche confessed that a good deal more time was still required in order to determine whether this speed would be attained. So much depended upon the nature of the permanent way.

This discussion, which followed, was of a congratulatory rather than of a technical character.

Sir William Preece, K. C. B., admired the candor with which the results of these experiments so far had been published, and then went on to eulogize the German Emperor, under whose eyes these experiments had been carried on and whose far-seeing genius seemed determined to put his country at the head of industrial nations. It was noteworthy that whereas in Germany much expense had been gone to to make experiments, in England the expense had been in order to prevent experiment. Although the Liverpool to Manchester high-speed line had been sanctioned by Parliament, the money to construct it was wanting. He was convinced that three-phase working was essential to the success of high-speed railways, and the experiments detailed in the paper were a distinct step in advance.

Herr Rathenau, of the Allgemeine Elektricitäts Gesellschaft, pointed out that the adoption of such railways on the Continent was handicapped, inasmuch as the present steam lines were a state monopoly. The situation being altogether the reverse in England, from England must the greatest development be expected.

Professor Sylvanus P. Thompson, F. R. S., in his usual fluent style, regarded the paper as an epoch-marking one. In this case one of the largest Continental firms had felt justified in spending a large amount of money in order to experiment, and until British manufacturers realized this as a high road to success, they must expect to be forestalled.

Mr. Alexander Siemens, Professor Carus-Wilson and others also spoke, and the chairman, in moving a vote of thanks to the author, suggested that railway companies as well as manufacturers ought to facilitate these experiments.

"The Protection of Trolley Wires" was the subject title of the next paper, which was sent in by Professor Andrew Jamieson, and in view of the frequency of accidents caused by the contact of telephone and telegraph wires with trolley lines, it must be conceded that this came at an opportune moment. These accidents, Professor Jamieson stated, proved that as long as telegraph, telephone and electric light wires were permitted to cross tramway routes, so long were accidents to be looked for. No less than eight trolley wire guards were illustrated and described, and altogether the whole subject was treated at some length, but we were disappointed to find the author coming to the rather obvious conclusion, after all this detail, that there would be no necessity for guard wires if all the non-tramway conductors were placed underground. Even to the lay mind this is apparent, and, as a matter of fact, all the main telephone cables in the new Glasgow system are placed underground in cast-iron pipes.

The meeting concluded with two papers of lesser importance, *viz.*, "Electricity Meters of the Electrolytic Type," by Mr. J. R. Dick, and "Kelvin's Measuring Instruments," by Professor Magnus Maclean.

Section IV, Naval Architecture and Marine Engineering—President, the Earl of Glasgow. Among the papers read before this section was one by Mr. Robert Robertson on "Electrical Power Supply in Shipbuilding Yards and Marine Engine Works." In this it was affirmed that electrical driving in marine works resulted in three advantages, *viz.*, saving in cost of power, flexibility and increased output. The advantages obtained by the extended use of portable tools electrically driven were very great, and it had been testified by those who had adopted the system that a reduction in the cost for labor resulted in addition to a substantial increase in the output. The author confidently maintained that in new shops and shipyards the adoption of electrical power was undoubtedly the best policy; and further, that in most cases it would pay to make the change in existing works.

A short discussion followed in which Mr. Napier supported the author of the paper that electricity would be the future power for shipyard use, and Mr. de Russett, of Messrs. Swan & Hunter, pointed out some advantages of pneumatic tools in such work as chipping, calking, etc. At the same time he favored the erection of large central electric stations for a supply in bulk, rather than each individual establishment having its own plant.

Section IX, Electrical—Three papers were on the programme for the section as follows: (1.) "The Relative Advantage of the Three, Two and Single-Phase Systems of Feeding Low-Tension Networks," by M. B. Field. (2.) "Modern Commutating Dynamo Machinery," by H. M. Hobart. (3) "Continuous-Current Dynamo Design," by Mr. H. A. Mavor. This latter was characterized by the author as a humble contribution to a systematic treatment of the subject, and in it he put into simple mathematical form certain practical considerations in connection with dynamo design in order that they might be used for the systematic treatment of the subject on practical lines.

Section III, Mechanical—A paper of electrical interest in this section was read by Mr. J. Crighton and Mr. W. G. Riddell, and was entitled "Power Required to Drive Marine Engine Works and for Electric Lighting." The intention of this was to show the results of a few improvements which had been adopted by the firm with which the authors were connected. As a result of a thoroughly up-to-date installation of electrical drawing, etc., costs in this factory had been reduced by 52 per cent, notwithstanding which, it was still abundantly clear that further reduction was possible.

While it can not be denied that in view of the multitude of papers on extremely important subjects, each one must necessarily have been imperfectly discussed in the short time during which each section was sitting, yet the congress as a whole will assuredly leave its mark for the good of the future of engineering all over the world. The success which attended the function makes it perfectly plain that it should be renewed at intervals within the British Isles. Over 150 papers were submitted to the nine sections during the three days the congress was sitting.

Glasgow, September 20.

AMERICAN STREET RAILWAY ASSOCIATION.

ITS ANNUAL CONVENTION TO BE ONE OF GREAT INTEREST AND UNUSUALLY LARGE ATTENDANCE.

The executive committee of the American Street Railway Association will convene in the parlors of the Murray Hill Hotel, New York, on Tuesday, October 8. At this meeting the details of the programme and plans of the convention will be completed and announced. The annual convention will be called to order the day following, October 9, in the meeting room of Madison Square Garden, where the sessions of Wednesday and Friday will be held. From reports received, the attendance will undoubtedly be the largest and most representative ever assembled.

Under the agreement made at the last convention at Kansas City, the entire day Thursday, October 10, will be devoted by the delegates and visitors to visiting and inspecting the exhibits which will fill every nook and corner of Madison Square Garden, and which will cover every branch of electric railway work and supplies. As this issue of the ELECTRICAL REVIEW goes to press a number of the exhibits have already come in and are being received at Madison Square Garden, and it is thought by Monday almost the entire display will be in position. The New York Telephone Company, with prompt courtesy, has arranged with Mr. H. H. Vreeland, chairman of the general committee, to furnish telephone service at the Garden during the convention of the Railway Association. This equipment will consist of a switchboard with capacity sufficient to place a telephone station in the spaces assigned to New York city exhibitors, furnishing them service at the station during the three days that the Garden is open.

The general committee of the American Street Railway Association is composed of the following-named gentlemen:

H. H. Vreeland, chairman, president Metropolitan Street Railway Company, 621 Broadway, New York.

J. L. Greatsinger, president Brooklyn Rapid Transit Company, 168 Montague street, Brooklyn, N. Y.

David Young, vice-president North Jersey Street Railroad Company, 29 Exchange place, Jersey City, N. J.

Colonel N. H. Heft, New York, New Haven & Hartford Railroad Company, New Haven, Ct.

Edward A. Maher, president Union Railway Company, 204 East 128th street, New York.

D. B. Hasbrouck, vice-president Metropolitan Street Railway Company, 621 Broadway, New York.

A. M. Young, president Bridgeport Traction Company, 100 Broadway, New York.

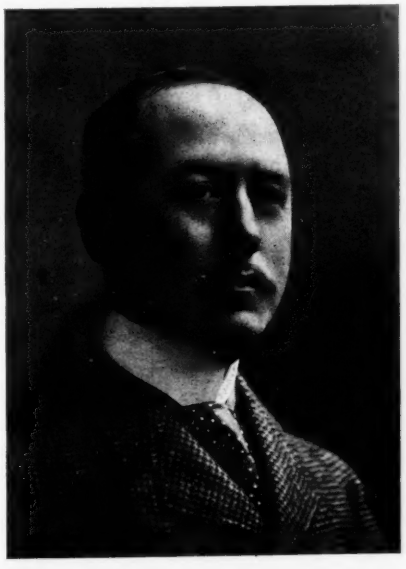
John R. Beetem, vice-president New York & Queens County Railway Company, 7 Borden avenue, Long Island City, N. Y.

E. P. Bryan, general manager Subway, Park Row Building, New York.

Alfred Skitt, vice-president Manhattan Railway Company, 195 Broadway, N. Y.

James H. McGraw, *Street Railway Journal,* 120 Liberty street, New York.

General Eugene Griffin, General Electric Company, 44 Broad street, New York.



MR. W. H. HOLMES, OF KANSAS CITY, MO., PRESIDENT OF THE AMERICAN STREET RAILWAY ASSOCIATION.

B. H. Warren, Westinghouse company, 120 Broadway, New York.

Harry Sanderson, president New York Electric Vehicle Transportation Company, Forty-ninth street and Eighth avenue, New York.

Frank J. Sprague, Sprague Electric Company, 20 Broad street, New York.

Henry L. Shippy, treasurer John A. Roebling's Sons Company, 117 Liberty street, New York.

John L. Heins, president Coney Island & Brooklyn Railroad Company, De Kalb and Central avenues, Brooklyn, N. Y.

Clinton L. Rossiter, president Rossiter, MacGovern & Company, of New York.

The reception committee of the association is composed as follows:

Colonel T. S. Williams, vice-president Brooklyn Rapid Transit Company, 168 Montague street, Brooklyn, N. Y.

A. C. Tully, general purchasing agent Metropolitan Street Railway Company, 106 West Fifty-first street, New York.

Charles E. Warren, secretary Metropolitan Street Railway Company, 621 Broadway, New York.

E. H. Mullin, General Electric Company, 44 Broad street, New York.

James M. Wakeman, vice-president *Street Railway Journal,* 120 Liberty street, New York.

Henry W. Blake, *Street Railway Journal,* 120 Liberty street, New York.

E. C. Long, Peckham company, 26 Cortlandt street, New York.

L. B. Stillwell, electrical engineer Manhattan Railway Company, 32 Park Place, New York.

Harold P. Brown, Plastic Rail Bond Company, 120 Liberty street, New York.

Giles S. Allison, 57 Broadway, New York.

Jacob Wendell, Jr., Wendell & MacDuffie, 26 Cortlandt street, New York.

Charles W. Price, editor ELECTRICAL REVIEW, 13 Park Row, New York.

H. A. Robinson, solicitor Metropolitan Street Railway Company, 621 Broadway, New York.

Preparations for the St. Louis Fair.

The letting of contracts aggregating $11,000,000 for construction work on the buildings and grounds of the Louisiana Purchase Exposition will begin about December 1. It is planned to apply about $7,000,000 of this amount on the buildings and about $4,000,000 on the grounds. The letting will begin with the contracts for four big exhibit buildings which, with their surroundings, will, it is estimated, cost about $4,000,000. The main buildings will be larger than those of any previous exposition in Europe or America. Some will exceed similar buildings at former expositions by over 25 per cent.

The site has been selected to embrace the unfinished half of one of the largest public parks on earth—Forest Park. The part of the park to be used contains 668 acres, and about 300 acres of surrounding property will be added to bring the entire area of the site up to about 1,000 acres.

The ground plans of the exposition have been drawn up by a commission of architects in which every section of the country was represented. Isaac S. Taylor, of St. Louis, was its chairman. The other St. Louis members are Eames & Young; Barnett, Haynes & Barnett; Widman, Walsh & Boisselier, and Theodore C. Link. New York was represented by Carrère & Hastings and by Cass Gilbert, of New York and St. Paul; Boston, by C. Howard

Walker; Kansas City, by Van Brunt & Howe; Omaha, by Thomas R. Kimball. The commission of architects had the advantage of the advice of a board composed of a sculptor, Mr. F. W. Ruckstuhl, of New York; a landscape engineer, Mr. Julius Pitzman, of St. Louis, and a landscape architect, Mr. George E. Kessler, of Kansas City, who laid out the boulevard and park system of Kansas City.

The details of the general arrangement have been worked out by Mr. E. L. Masqueray, of New York, as chief designer.

Mr. Masqueray received his early training in architecture at the École des Beaux Arts, Paris, and took a gold medal at the first salon at which he exhibited. He has for the past five years conducted an atelier in New York with a mission to introduce in America the educational methods in architecture used in France and on the European continent.

The site has been surveyed and the lines of buildings and avenues staked off.

The designs for the separate buildings, assigned to the individual members of the commission of architects, will be submitted in scale drawings by the middle of October and the working drawings of the main buildings to be let first will be ready by November 1. The lettings will be advertised for about three weeks in the leading technical journals throughout the world. There will be no geographical restriction on bidders. The main stipulation will be that the buildings be ready for occupancy at a date sufficiently far ahead of April 30, 1903, the date fixed for the opening of the exposition, to allow exhibitors time to prepare their displays for the opening. To secure the completion of the buildings by this time, a sufficient bond will be required of the successful bidders. Materials will be employed in the construction work and conditions will be so adjusted that contractors may fulfill their contracts.

All this work will be in direct charge of Mr. Isaac S. Taylor, of St. Louis, who is at the same time chairman of the commission of architects and director of construction and maintenance for the Louisiana Purchase Exposition. Over him will be only the unsalaried officials and directors of the Louisiana Purchase Exposition Company. It has been decided to do away entirely with the position of director-general, who, in most former important expositions, was at the head of the salaried forces and controlled practically all the departments, supervising the department of works, of exhibits, of publicity and promotion, of accounts and of concessions.

On advice of President Higginbotham, of the World's Columbian Exposition, at Chicago, and for patent reasons, one being that it would tax too severely the energies of one man to attend to all departments, the work will be divided among four chiefs—director of construction and maintenance, whose duties will be those of the director of works in former expositions; director of exhibits, who will have supervision over exhibits in all departments; director of concessions and admissions, who is to supervise the granting of all concessions and have charge of the collection of revenues from them and from admissions, and commissioner-general, who is to have charge of the accounts of the company.

All these department chiefs are to report to the executive committee and the board of directors, either through another committee or directly. Mr. Taylor, director of construction and maintenance, reports to the committee on grounds and buildings, a committee of seven members, and through them to the executive committee and the board of directors.

The St. Louis World's Fair is the first at which the same man was chairman of the commission of architects as well as director of construction and maintenance. This is the first great exposition in which the same man who led the planning of the exposition had the chieftaincy in carrying out the construction. The arrangement adopted in St. Louis is pronounced the ideal one by every person who has had a part in the construction of former expositions. Mr. Taylor had a large voice in the selection of the commission of architects and presided at their meetings from the beginning. On a trip to the East he engaged the chief designer, Mr. E. L. Masqueray, in New York.

The plan which will be pursued in the construction of a building at the St. Louis Exposition will be to let the entire building under a single contract, the contractor to have control of all the subcontractors. "This plan is by far the most satisfactory," says Mr. Isaac S. Taylor. "Where the exposition company lets subcontracts itself each subcontractor must be watched and it is difficult to fix responsibility for faulty work. For this reason, in former expositions the company had to pay extra for reconstruction of faulty work, and the cost of the extra swelled the total cost of construction immensely."

Mr. Isaac S. Taylor has been in St. Louis all his active life. He was born in 1851 in Nashville, Tenn. He was graduated from the St. Louis University with class honors in 1868. After studying for six years under the preceptorship of Architect George I. Barnett, of St. Louis, he was taken into partnership, and the business was then conducted under the firm name of Barnett & Taylor. The Southern Hotel, the first fireproof hotel in St. Louis, and still one of the finest hotels in the city, was erected by this firm.

In 1879 Mr. Taylor severed his connection with George I. Barnett and since then has been in business for himself in St. Louis. He has erected some of the biggest and best buildings in the city, and has done much work in Illinois and Texas.

GENERAL SPECIFICATIONS FOR A GASOLINE MOTOR CAR.

BY H. WARD LEONARD.

1. The relation between the horse-power of the motor and the weight of the car with tanks full shall be such that there will be not more than 200 pounds weight per brake horse-power of the motor.

2. The motor shall be placed forward in such a manner that its weight will be carried upon springs over the front axle; exposed to good air circulation; free from dust and mud; readily accessible, and so that any vibration due to the motor will not be objectionably felt by the passengers.

3. There shall be a spring-actuated cone friction clutch between the motor and the driving mechanism which can be opened by a pedal, so as to quickly disconnect the motor in the most simple and positive manner whenever this is desirable, and so that the power must be applied in a gradual manner to accelerate the car without detrimental shocks or strains. This cone friction clutch shall be so placed as to be readily inspected and shall be provided with simple means for quickly adjusting the tension of the spring which forces the frictional surfaces into contact.

4. There shall be a pedal-operated foot brake sufficiently powerful to readily hold the loaded car upon a 20 per cent grade either ascending or descending. This brake shall be so arranged that it will cause the friction clutch to be opened before the foot brake is applied. This foot brake shall be applied upon the main driving shaft between the motor and the differential so as to avoid all tendency to skidding. This foot brake shall be metal upon metal and shall be readily and promptly adjustable.

5. There shall be a very powerful hand-operated brake which will simultaneously apply two band brakes upon the hubs of the back wheels. These band brakes shall be readily and positively adjustable so that they can be adjusted to act exactly alike and thus avoid all tendency to skidding when this powerful brake is suddenly applied. This brake shall be made so that the operator's hand can be removed after the brake is applied without releasing the brake, thus making it possible to apply a strong brake and yet have the operator's hands free for other purposes. This brake shall be so placed that in applying it the operator does not have to move his body and thereby disturb his steering while he is applying the brake.

6. There shall be three principal forward speeds and one reverse speed. The reverse speed shall have a much greater re-

duction than any forward speed so as to reduce the risk due to backing the car in a bad place. All three forward speeds shall be controlled by a single lever which shall be mounted upon the steering column, so that the variable gear can be quickly and readily operated without affecting the steering. When the high-speed gear is in use there shall be no gear wheels of the variable speed gear in motion, so that the noise, wear and loss of power due to the use of gears shall be avoided during all usual operation of the car upon the level and upon moderate grades. The low-speed gear shall give a reduction sufficient to enable the car carrying its operator to readily ascend a grade of 20 per cent upon a good macadam road. Under such conditions the friction clutch shall not heat due to slipping.

7. The steering shall be by means of an inclined wheel with a sufficient reduction to be irreversible in ordinary operation. There shall be no lost motion in the steering mechanism. The steering mechanism shall be wholly above the level of the bottom of the axle so as to be as well protected as possible from being struck by obstacles in the road. All levers and joints in the steering mechanism shall be so placed as to be always in plain view and readily accessible so that any defect in the steering mechanism will be immediately apparent. The steering mechanism shall be so designed that the car can be turned in a 22-foot circle, thus making it possible to turn the car in any ordinary road without using the reverse gear.

8. In order to secure the greatest stability the height of the operator's seat above the road shall not exceed 42 inches. The length of wheel base for all cars capable of making 30 miles per hour shall not be less than 62 inches. The gauge of the wheels shall not be less than 46 inches.

9. For all cars weighing over 800 pounds (with tanks full) the tires shall be at least three inches in diameter.

10. A pump shall be placed so as to be readily manipulated by the operator while the car is in motion and which will enable the operator to positively oil the engine cylinder while driving the car at full speed.

11. The motor, variable gear and transmission mechanism shall be so enclosed as not to be affected by mud, dust or water and shall be run in a bath of oil.

12. The gasoline tank, water tank, etc., shall have capacity to operate the car for 125 miles without a stop upon good roads of moderate grades.

13. The water circulation shall be sufficiently efficient so that the car can be operated at full speed upon the lowest gear for 30 minutes without the water boiling, the water being at normal temperature at the beginning of the test.

14. The gasoline tank shall be placed in plain view in a readily accessible position so that any leak will be immediately detected.

15. The car shall be capable of making a maximum speed of 30 miles per hour on a good level road, a speed of 13 miles per hour up a 6 per cent grade and a speed of 6 miles per hour up a 15 per cent grade.

16. The lever for manipulating the variable-speed gear shall be so arranged that it is impossible to manipulate the variable-speed mechanism except while the friction clutch is open, thus making the manipulation of the variable-speed gear entirely "fool-proof," and also making it impossible to suddenly apply the momentum of the motor to the car, it being always necessary to apply the power through the friction clutch in a gradual manner, thus protecting all mechanism from abusive strains due to inexperienced or improper manipulation.

17. The rolling friction on a hard, level floor shall not exceed 20 pounds per 1,000. That is, a steady pull of 20 pounds applied by a spring balance shall keep in motion a 1,000-pound car on a level floor when the engine is disconnected from the driving mechanism.

18. All nuts which it is important to prevent from working loose shall be secured by means of efficient split pins.

19. The starting crank shall be so placed and so geared to the motor that the motor can be easily started with but slight manual effort.

20. The consumption of gasoline shall not exceed one pound of gasoline for each horse-power-hour of work, measured by brake test of the motor.

New York Rapid Transit Company Buys Land for Central Power-House.

The Rapid Transit Subway Construction Company, of New York, has purchased land for the site of its central power-house, which, it is stated, will be the largest of its kind in the world. The land, which has been held at $1,000,000, fronts on the Hudson River and is bounded by Fifty-eighth and Fifty-ninth streets and Eleventh and Twelfth avenues. The area is 800 by 200 feet.

The site bought for the central power-house of the Rapid Transit Railway System includes the water front on the river opposite the block. One of the main points made by Mr. J. B. McDonald, the contractor, was that the site should be central and commend itself to the citizens of New York as a proper one for such an important building. It is the company's desire to make the power-house an ornament to the city. It is stated that the General Electric Company, of Schenectady, N. Y.; the Westinghouse Electric and Manufacturing Company, of Pittsburgh, Pa., and the Stanley Electric Manufacturing Company, of Pittsfield, Mass., are the three companies bidding for the entire electrical equipment of the system.

Commercial Pacific Cable Company.

This company has been incorporated at Albany, N. Y., for the purpose of laying a submarine cable from the Pacific coast to Hawaii and thence to the Philippine Islands, thus making a direct cable route from the United States to the far east. According to the articles of incorporation the company's lines are to begin in New York city, but from that point to the Pacific coast lines of other companies may be used. The actual lines of the company are to begin at some point in California and end in the Philippine Islands. Hawaii is to be touched by these lines as well as various other Pacific islands. The capital stock of the company is $100,000, divided into shares of $100 each.

This company will be affiliated with the Commercial Cable Company and all its incorporators are officials of that corporation. Mr. John W. Mackay states that the length of the cable will be about 8,500 miles. The first part laid will be from California to the Hawaiian Islands, a distance of about 2,200 miles. It is expected that this portion will be laid and in operation within nine months. The time required for the laying of the remainder of the cable from the Hawaiian Islands to the Philippine Islands will depend upon how quickly the cable can be manufactured. Mr. Mackay believes that the whole cable will be in operation within two years from the present time. Application has been made to the United States Government for landing rights in California and the Hawaiian Islands and the Philippine Islands, and such application is still pending. The new company is willing to lay the cable on the same terms and conditions as regards landing rights as were imposed by the United States Government on the cable lines which have been landed on the Atlantic coast of the United States.

The first award of the Osiris prize in 1903 will be made by the French Institute. This prize is of the value of 100,000 francs and is awarded to the one who, in the preceding three years, accomplishes the most important work for science, industry or literature.

Telephone Systems in Private Houses.

The private house of to-day, instead of being equipped with a speaking tube as was the custom a few years ago, generally has a modern telephone system connecting the various departments with each other. The main advantage of the telephone over the speaking tube is that one outlet or one telephone can be used to communicate to all of the different stations, whereas, when the speaking tube was used, a separate mouthpiece was needed for each and every station.

FIG. 1.—HAND MICROTELEPHONE.

In locating these outlets for the telephone great care should be taken in placing them where they will be most convenient for the use of the household, with consideration at all times for the continuous daily work, and also where they will not interfere with any of the fittings of the house which are to be installed at a later date, such as radiators, sideboards, etc. A very convenient place is near the casing of the door, as it is almost impossible to place any heavy article of furniture near a door. Caution should be used in first discovering which way the door is to swing.

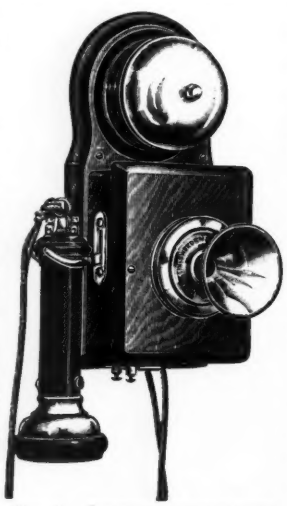


FIG. 2. INTERCOMMUNICATING WALL TELEPHONE SET.

The wire cable which is used in connecting the various stations should run as far from the water pipes as possible on account of breaks in the pipes which are liable to occur, the moisture from which would injure the wires, make cross-connection, cause leaks of current and soon destroy the vitality of the battery. A cable having a weather-proof insulation is preferable, not only on account of the properties which prevent moisture from entering the same, but also because a cable of this kind is not attacked by rats or mice. These animals gnaw the insulation in the ordinary cable, and, while they do not injure the wires, they frequently cause crossing or grounding of wires which is difficult to locate and is very annoying both to the owner and the electrician.

Wall pockets or receptacles for holding the telephone are very useful at the outlets, for, while keeping the telephones fully covered, they do not deface the walls, and by their use many of the connections can be made inside and a buzzer or a bell can be placed within for the purpose of calling that station. The telephone itself can be very small and compact and by using the hand microtelephone in connection with a selective switch, as shown in Fig. 1, an instrument having a capacity of 15 stations will occupy a space of only four or five inches square.

Woodwork in special design and finish is often used to match the finish of the room, and thus the telephone can be made an ornament as well as a great convenience. In some mansions the wooden cases have been made of solid ebony, rosewood or other costly woods, while the metal parts have been gold-plated.

As to the construction, the cable itself should be installed while the house is in process of construction and should be put in place before the studding is covered with lath and plaster. The instruments themselves should not be placed on the wall until all the workmen have left the building for good, as telephones are apt to be regarded as an object of curiosity by workmen doing other work, and oftentimes considerable damage is done by their carelessness. The Ericsson Telephone Company, of New York, N. Y., manufactures telephone apparatus adapted for household purposes. Two patterns of simple instruments are shown in Figs. 1 and 2.

The Kronprinz Wilhelm.

The latest addition to our transatlantic passenger fleet is the Kronprinz Wilhelm, of the North German Lloyd Line. This magnificent new twin-screw steamship made her maiden voyage last week, and received a baptism from old Neptune in the form of a tidal wave that caused some slight damage and delay. However, she made the best day's run ever made on a maiden voyage. The Kronprinz Wilhelm is probably the largest and best ship of the line, and is fitted up luxuriously with every modern convenience, including a complete telephone system between staterooms and offices, and for signaling purposes throughout the ship. A wireless telegraph system is also installed.

On Friday evening of last week a reception and dinner were given on board, and were attended by about 200 guests. Mr. Frank Presbrey, representing the North German Lloyd interests, presided, and a number of addresses were delivered commending the enterprise of the company, and toasting the closer relations that the work of this line was bringing about between the United States and Germany.

Rossiter, MacGovern & Company.

The business of Rossiter, MacGovern & Company, of New York city, has so expanded during the past year that increased capital and facilities have been arranged for. Mr. Clinton L. Rossiter, formerly president of the Brooklyn Rapid Transit Company, has accepted the presidency of this well-known electrical and steam machinery house, and will devote a portion of his time to the company's affairs.

Mr. Frank MacGovern will continue as vice-president and manager. Mr. MacGovern is one of the most widely known men in this branch of the electrical business and is to be credited with building up an organization known to the electrical men in all parts of the United States. Under his energetic management the house is establishing branch offices and warehouses in several western cities, notably in St. Louis and Cincinnati.

Mr. Charles W. Morse Purchases Control of the Telephone, Telegraph and Cable Company.

It was announced on Tuesday of this week that Mr. Charles W. Morse, president of the Bank of New Amsterdam, of this city, and formerly president of the Consolidated Ice Company, had completed the purchase of the Telephone, Telegraph and Cable Company of America, a company organized to operate telephone exchanges in opposition to the Bell companies. Mr. Morse is said to have paid for the control of the company 50 per cent of the investment of former stockholders. It is believed that Mr. Morse will take the presidency of the company, and have associated with him as general manager Judge J. M. Thomas, of Cleveland, the former president of the company.

Mr. U. N. Bethell, of New York, General Manager of the Chesapeake & Potomac Telephone Company.

Mr. U. N. Bethell, general manager of the New York Telephone Company, was recently elected general manager of the Chesapeake & Potomac Telephone Company, Washington, D. C. Mr. Bethell will continue as general manager of the New York company, and will, in addition, devote a portion of his time to the management of the interests of the Chesapeake & Potomac company.

World's Coal Production.

The London Board of Trade has issued its report on the production of coal in the various countries of the world, which is printed and discussed in the *London Economist*. In view of the controversy aroused by the imposition of the export tax, the figures are of more than usual interest. It is explained that the totals for the year 1900 are necessarily, in many cases, estimates only, as the definite returns are not yet available for all countries. The following is a statement of the output of the principal coal-producing countries for the past five years:

(000's omitted.)

Country.	Tons. 1900.	Tons. 1899.	Tons. 1898.	Tons. 1897.	Tons. 1896.
United Kingdom	225,181	220,095	202,055	202,130	195,361
United States	245,422	226,554	196,406	178,930	171,416
Germany	109 225	101,460	96,310	91,055	85,690
France	32,587	32,256	31,826	30,337	28,750
Belgium	23,352	22,072	22,088	21,492	21,252
Russia	.....	14,565	12,185	11,171	9,351
Austria-Hungary	.....	12,694	12,186	11,611	11,033
Spain	2,773	2,565	2,434	2,011	1,853
Japan	.....	6,722	6,696	5,188	5, 20
India	.....	4,937	4,606	4,063	3,848
New South Wales	5,507	4,597	4,706	4,384	3,910
Canada	4,761	4,506	3,726	3,380	3,344

It will be seen that the United Kingdom has, in the past two years, given way to the United States as the largest coal producer, though, of course, the production of this country is still far ahead of any other in proportion to area and population. The report states that the total production of the world is about 650,000,000 tons per annum, of which the United Kingdom produces rather more than a third, and the United Kingdom and the United States together account for nearly three-quarters. Another table of considerable interest shows the proportion of the output which is sent abroad. Out of 225,181,000 tons produced in 1900, 58,405,000 tons were shipped abroad, the proportion exported being 26 per cent. In 1890 our exports were 38,660,000 tons, out of a total production of 181,614,000 tons, or 21 per cent. In other words, while the home consumption has increased by 16.6 per cent, the exports have risen to the extent of 43.3 per cent. The return obtained last year, for the first time, showing the quantity of coal consumed for locomotive purposes by the railway companies in the United Kingdom has been continued in the present number. The amount of coal so consumed was 11,166,388 tons in 1900, as against 10,636,172 tons in 1899. Similar information is also available in the case of a few other countries. In France the amount so used in 1899 amounted to 5,404,000 tons. In Belgium the amount consumed on the state railways amounted to 1,153,913 tons.

Steam Mesh Separator and Superheater.

This separator, which is shown in Fig. 1, is known as the Potter mesh separator and superheater and is sold by James Beggs & Company, of New York, N. Y. It consists of a number of metal bands with a piece of wire cloth between each pair, supported by heavy castings. The whole is bolted together and fitted to the steam outlet inside the boiler. The shape of the separator can be altered to suit any conditions. The most radical and important peculiarity of this separator is that it is designed to be placed in the steam space of the boiler or in the dome, therefore dispensing with dry pipes.

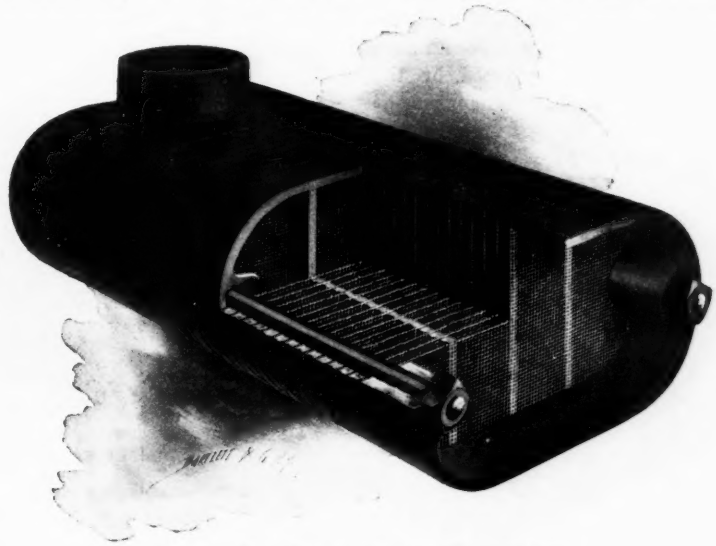


FIG. 1.—MESH SEPARATOR AND SUPERHEATER.

This departure from the ordinary practice of relying entirely upon steam separators placed in the steam mains or branches to prevent condensed and wet steam from being carried over to the engines is said to be an entirely original one. By the separator being placed in the boiler itself all the steam is compelled to first pass through the separator where it is made absolutely dry and increased in temperature. At the same time, the moisture returns to the boiler automatically. As the separators are placed inside the boilers they interfere in no way with existing pipe lines in old plants. The line separator, with its trap or pump valves, gauge glass, etc., is unnecessary except in very long steam pipes.

The layers of wire mesh, to a large extent, take up the pulsations due to the motion of the piston and reduce the drag on the water in the boiler. As the result of this there is a supply of good steam flowing into the separator which is still further improved by contact with the wire gauze. The small globules of moisture, which steam direct from the boiler always contains, are broken up by the first piece of gauze, then further broken up by the second and so on until completely atomized and ready, on the addition of a small amount of heat, to be flashed into dry steam. This heat is obtained by a very small amount of wire drawing, the pressure being reduced to about one per cent. Consequently, dry steam of high efficiency is supplied at the steam outlet.

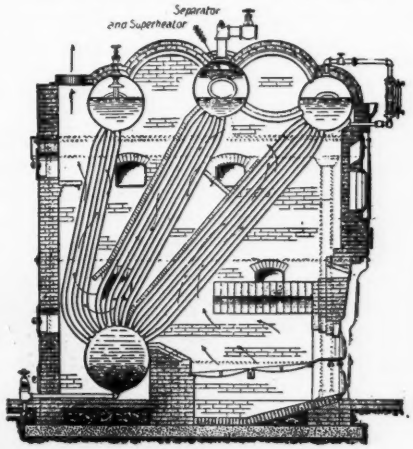


FIG. 2.—SEPARATOR IN STEAM-DRUM OF STIRLING BOILER.

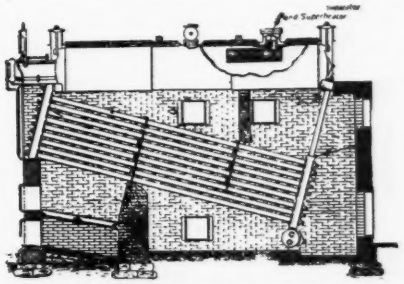


FIG. 3.—SEPARATOR IN STEAM-DRUM OF BABCOCK & WILCOX BOILER.

This separator should be placed as close as possible to the back of the shell of the boiler or top of the steam drum, with the outlet fitting into the steam outlet of the

boiler, as depicted in Figs. 2 and 3. It is not necessary to make this point steam tight. The separator is supported by two or more small studs or tap bolts to the shell of the boiler or suspended by hangers. In a few hours' time the separator can be easily installed by an engineer or steam fitter.

A New Pin and Insulator.

Something new in the way of pins and insulators, which are shown in the illustration, has just been introduced by the Fletcher Manufacturing Company, of Dayton, Ohio.

This apparatus is known as the Etheridge pin and insulator. The pin consists of a hollow tube with shoulder thereon.

Pin and Insulator.

A flat spring of high carbon steel, with hooked or curved ends, is then forced into the tube until the hooks pass out over each end of the tube.

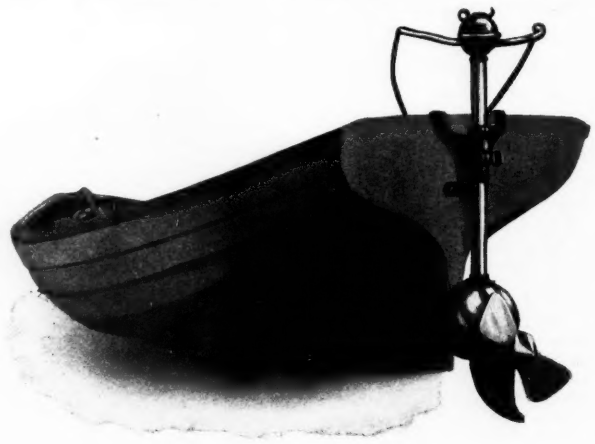
The insulator consists of any of the well-known styles and is provided with a plain parallel centre hole with an annular dovetail recess at the bottom of the hole. The pin is locked into the cross-arm by forcing the pin through the opening in the arm until the hook passes out over the under side of the arm; and is removed by forcing the hook flush with the opening in the arm and withdrawing the pin. The insulator is locked to the pin by forcing the insulator down over the pin until the hook passes out in the annular dovetail recess, and is removed in the same manner as in removing from the cross-arm.

The manufacturer states that the feature of the insulator is that it is free to turn on the pin, and in the angles of the line acts as a shieve for the wire when erected and thereby takes a great deal of strain off the pin. The insulator being loose on the pin, also compensates for the expansion and contraction, and thereby avoids the breaking of insulators.

With this form of construction it is only necessary to use a single arm in the angles of the line, and the expense involved in double arming the angles to provide pin strength is thereby very largely reduced.

New Submerged Electric Motor

The submerged electric boat propeller is a new invention and possesses many interesting features. It is manufactured by the Submerged Electric Motor Company, of Menominee, Wis. This propeller is especially adapted for use on row boats, fishing, hunting or pleasure boats of all kinds. The apparatus is portable and comes in three parts, the whole weighing but 135 pounds. It occupies the place of the rudder and can be placed in position on any boat or exchanged from one to another in five minutes.



Submerged Electric Motor.

The motor itself is under water while the storage batteries are in such compact form that they can be placed out of the way under the seats of any ordinary row boat. The motor not only propels the boat but steers it as well, the boat answering to it more readily than to a rudder. It is simple in construction and not likely to get out of order. Any one can operate it. Being under water it is absolutely noiseless.

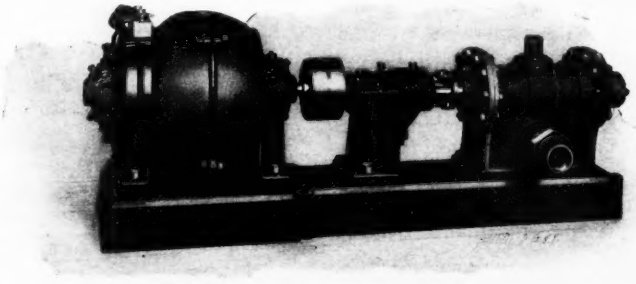
This motor drives the boat forward or backward and can be regulated to run at any speed up to four miles per hour, using two boxes of four cells, and will run from 20 to 30 miles on one charge. More cells may be used and a speed of six miles an hour attained if desired. Special means of lubrication of all its working parts are provided which insures durability.

This motor is especially advantageous to the fisherman who desires to run his boat noiselessly, steer it and troll or cast at the same time.

The accumulators used in the storage batteries have a large surface of active material and are said to be capable of retaining a larger per cent of the current with which they are charged than any others on the market, and this, with the high efficiency of the motor, gives to boats equipped with this apparatus a large radius of travel. Double the arrangement of boxes may be used to acquire a desired fixed speed, and the efficiency of the battery is materially increased at a low rate of discharge if this is done. This provides the advantage of being able to so group the battery as to make 10 or 15-minute spurts at a much higher rate of speed than that ordinarily used. For this arrangement the boat has to be especially wired and a special switch added.

Electric Motors for Pump Service.

An electric motor attached to a pump offers a good solution of the important problem of providing an adequate water service on the upper floors of the modern high buildings. The motor and pump are placed in the cellar of the building to be protected and the water is pumped to a pressure tank at the top. The tank is provided with a regulator for putting the motor into operation as often as may be required and thus keeping the apparatus in perfect working order. The accompanying illustration shows a Lundell round type enclosed motor direct-connected to a Quimby screw pump. The Lundell motors are manufactured by the Sprague Electric Company, whose direct-current apparatus has a world-wide reputation for efficiency, durability and general workmanship.



Motor Direct-Connected to Pump.

Current Electrical News

COMMERCIAL NEWS

DOMESTIC AND EXPORT

It is reported that the Imperial Electric Company, of Montreal, Quebec, has been amalgamated with the Heat, Light and Power Company.

The Royal Electric Company has formally accepted the proposition of the city council of Montreal, Quebec, to light the streets of that city at the price of $60 per lamp per year.

The British Columbia Electric Railway Company and the Vancouver Power Company will soon expend $600,000 in developing the water power of the Coquitlan for transmission to Vancouver and New Westminster. It is expected that 5,000 horsepower will be generated.

A representative of the Marconi wireless telegraphy system has arrived in St. Johns, Newfoundland, to open a station on Cape Race. From the general outline of the land he hopes to be able to send messages 160 miles to sea. This station will be the first operated in the colony of Newfoundland.

Between Juneau and Skagway, Alaska, the government telegraph cable has been successfully laid and is now in operation. With the completion of the construction of the short gap in the line between Glenora and Ashcroft, in British Columbia, Juneau will be in telegraphic communication with the rest of the world.

The Everett-Moore Syndicate, which owns the street railways of Cleveland and Canton, Ohio, is about to buy some railroads in Wheeling and Martins Ferry, and the Steubenville, Mingo & Ohio Valley Traction Line to Brilliant and Steubenville. When the deal is completed a line from Steubenville to Canton will be constructed.

Mr. S. B. Downer has filed articles of incorporation for the Michigan & West Shore Traction Company, which has secured a franchise along certain streets of Benton Harbor, Mich. The capital stock is $1,350,000. He has filed a mortgage to the American Trust Company, of New York, for a like amount which is to be used to construct, maintain and equip the new electric system. The contract has been let to Weston Brothers, Chicago, Ill.

The franchises granted to the Mellon Syndicate through the streets of Allegheny, Pa., are in such shape now that active building operations are to be started at once. Additional traction lines within the confines of Allegheny to the extent of 20 miles of new track and the expenditure of $2,750,000 are to be built. The officers of the company are bending every energy toward completion of these new lines, all of which will form a component part of the entire Mellon Syndicate.

By listing the value of the Chicago Union Traction Company's franchise in the western division of Chicago at $1,000,000, the Board of Review has taken the initial steps to have the Supreme Court pass upon the much mooted question whether or not these rights are taxable. The county clerk, in accordance with the instructions of the board, will issue a tax warrant covering this amount and with the expected refusal of the railway company the matter will be taken into the highest courts.

Auckland, New Zealand, in addition to having an up-to-date electric traction system, is also to be lighted by electricity, the local municipal authorities, according to mail advices just received, having decided to sanction the innovation. The electric lighting of the Australasian city will, of course, mean additional expenditures as to equipment and there is good reason to believe that a large proportion of the necessary plant will be purchased in the United States.

The Compagnie Francaise de Chemins de Fer de l'Indo-Chine et du Yunnan is the title of a company which a syndicate of Parisian bankers has recently formed for the purpose of constructing railroads in the far east. The railway upon which the concession is based will have a total length of 528 miles, of which 238 miles will be in Tonquin and 290 miles in China. It is provided by the concession that the section on Chinese territory shall be constructed and worked by the company, while that in Tonquin will be built by the colony and its operation entrusted to the company.

The great canal and power-house at Massena, N. Y., are nearing completion after several years' work. Some of the big steam shovels and dredges have already been moved to other fields and those which remain are working in spots where the nature of the soil is such that speedy work is out of the question. The contractors say that by October 1 they will be through and in and about Massena there is hope that the company will develop some power by January 1. The power-house has now been nearly completed and the installation of the electric plant has just been started.

The St. Joseph & Elkhart Power Company is now constructing a large dam at Twin Branches on the St. Joseph River between South Bend, Ind., and Elkhart, Ind. The company owns the Elkhart electric light plant and has a franchise from the city of South Bend to furnish heat, light and power in that city. Most of the power will be used to develop manufacturing enterprises in which the company is interested. When complete the dam will furnish 7,000 horsepower which the company expects to sell to consumers at so low a price that the St. Joseph valley for a radius of 25 miles will become a great industrial centre.

A most thorough demonstration of the efficiency of the electric fireproofing process operated by the Electric Fire Proofing Company, Limited, of Canada, has been witnessed on the Champ de Mars, near Montreal. A house built entirely of wood, treated by this process, was tested by placing under and beside the same a large amount of kindling and fire wood saturated with kerosene which was then set on fire. The structure, however, could not be made to burn and the result of the experiment proved most successful in that it left the house in almost perfect condition after having been subjected to a furnace heat for over one hour and a half.

It has been announced in the Philadelphia papers that the Consolidated Traction Company, of Pittsburgh, is to be merged with the Philadelphia company in which Mr. P. A. B. Widener and Mr. W. L. Elkins are heavily interested, and which has taken out an omnibus charter allowing it to operate almost anywhere and everywhere provided it obtains the consent of local stockholders. The capitalization of the Consolidated company is $30,000,000, of which $25,000,000 has been issued. The Philadelphia company's authorized capitalization is $21,000,000, of which nearly $19,000,000 has been issued. It also has a bonded indebtedness of $4,250,000.

ELECTRIC RAILWAYS

The Tampa Electric Company, of Tampa, Fla., now has its new bay shore line in operation to Ballast Point.

The extension of the Worcester Consolidated Street Railway, of Worcester, Mass., to West Milbury is being agitated.

The West Michigan Traction Company, of Marquette, Mich., is buying land for a terminal on the flats in Benton Harbor.

The construction work of the Columbia & Montour Electric Railroad has been completed between Bloomsburg, Pa., and Berwick.

The extension of the electric railway which is to give to the people of Johnstown, N. Y., rapid transit to Amsterdam will be built this fall.

The survey for the electric railway in Gilsum, N. H., has been begun by Mr. George W. R. Harriman, of the firm of Harriman Brothers, Boston.

Good progress is being made upon the electric railway from West Rutland, Vt., to Fair Haven, which is being built by the Rutland Street Railway Company.

The Springfield Street Railway Company, of Springfield, Ohio, has decided to spend $15,000 before the opening of next season in the improvement of Spring Grove Park.

A franchise has been granted by the people of Savannah, N. Y., to the Rochester-Syracuse Trolley Company for a trolley line to pass through the village and town of Savannah.

It has been learned that the Detroit & Toledo Shore Line Railway, of Toledo, Ohio, is quietly acquiring a right of way for an extension from its present terminals to the river front.

The city council of Elkhorn, Wis., has voted to grant a 50-year franchise to Mr. George J. Hurd, of Janesville, for the construction and operation of an electric road through that city.

The outside work on the new power-house of the Wilmington City Railroad, of Wilmington, Del., is nearly finished and it is now ready for the machinery which is expected to arrive shortly.

The franchises for the Omro-Oshkosh Electric Railroad, of Omro, Wis., between Omro and Oshkosh have already been secured. The line will be constructed to carry passengers, mail, express and freight.

At a meeting of the executive committee of the United Railways the plans for building an extension to Sparrows Point, Md., were discussed, and it was decided to go ahead with the work so as to finish the line this winter.

The annual meeting of the stockholders of the Bennington & Hoosic Valley Electric Railway Company, of Bennington, Vt., has been held. The business of the road for the last year was reported satisfactory. The new managers of the road have expended about $9,000 in repairs on the line.

The annual meeting of the stockholders of the Granville-Whitehall Electric Railroad, of Granville, N. Y., has been held and the same board of directors reelected. The board afterward met and elected the same offi-

cers. It was voted to reduce the capital stock from $750,000 to $400,000.

The articles of association looking to the formation of the Gardiner Street Railway Company, in Maine, have been sent to the railroad commissioners for their endorsement. As soon as they are returned the necessary steps will be taken to secure a location for a street railroad in Gardiner, Me.

The Toronto Street Railway Company, of Toronto, Ontario, has bought all existing suburban electric lines and will extend the system to Hamilton on the west, and Oshawa on the east. It will be a system something after the nature of the International Traction Company, of Buffalo, N. Y., and will probably be operated by power from Niagara Falls.

Early in October it is probable that the motive power of the Bath Beach and Fifth avenue elevated lines of the Brooklyn Rapid Transit Railway will be changed to electricity. It is impossible to make this substitution in general until the four transformer stations now being constructed are completed. These will be ready for operation in about six months.

A number of the citizens of Baltimore are interested in an undertaking to build a connecting link so as to give through electric railway service from Philadelphia, Pa., to Trenton, N. J. Under the name of the Neshoming Elevated Railway Company a corporation has been organized to build the connecting link. Mr. George Blakistone is the president of the company.

Papers announcing the consolidation of the Golden's Bridge Electric Railway Company, of Westchester County, N. Y., and the Danbury & Golden's Bridge Street Railway Company, of Danbury, Ct., have been filed in the county clerk's office. The Danbury & Harlem Traction Company is the name of the new corporation. It has 15 directors and its capital stock is $300,000.

Mr. F. E. Reid, of Kansas City, Mo., and J. L. Brown, representative of Dennison, Prior & Company, bankers of Cleveland and Boston, have appeared before the county court in St. Joseph, Mo., and asked for a franchise for the Kansas City, Parkville & St. Joseph Electric Railroad. It was stated that the company is largely interested in the Home Riverside Coal Company, of Leavenworth.

Colonel W. H. Chase, of Atlanta, Ga., who has just been in New York conferring with capitalists there has returned and reports that the New York capitalists were well satisfied with his report as to the opening here for such an enterprise and that as soon as the city council grants a franchise he is ready to begin the work of building and equipping the line. He also states that with good weather cars will be running within three or four months.

The Worcester Consolidated Street Railway Company, of Worcester, Mass., has been before the railroad commissioners as a petitioner for authorization to issue $500,000 additional capital stock. Counsel Warren stated that the company wished to make purchases of real estate, erect a number of buildings which were necessary for the proper handling of the company and to add to the rolling stock and equipment. The matter was taken under advisement.

A deal for the transfer of a controlling interest in the Johnstown Passenger Railroad Company, of Johnstown, Pa., to Mr. T. C. DuPont, of Wilmington, Del., by the coterie of Johnstown people which acquired the T. L. Johnson holdings early in the summer. It is understood that Mr. DuPont has associated with him eastern capitalists and that their plan is to increase both the capital stock and the indebtedness of the company from $800,000 to $2,000,000, in order to give more working capital and permit the carrying out of plans already on foot.

ELECTRIC LIGHTING

The new municipal electric lighting plant in Sioux Falls, S. D., is now in operation over a portion of the city.

The Warren Featherbone Company, of Middleville, Mich., has installed a 300-light electric plant in its factory.

The lighting committee of the city council of Atlantic City, N. J., is considering plans for a municipal electric light plant.

Great efforts are being made by those interested in the Consumers' Electric Light, Power and Heat Company, of Johnstown, Pa., to advance the interests of that concern.

A large engine is being installed in the electric light plant at Parkersburg, W. Va., to assist in the generation of power for the Parkersburg & Interurban Street Railway Line.

The Belton Electric Light and Power Company, of Belton, Tex., has received its large dynamo and placed it in position. The company is removing all old wires and putting in new ones throughout the city.

Work on the new electric light plant in Albany, Ga., has been begun by the firm of Moore & McCrarey, of Atlanta, Ga. The boilers and engines have arrived and are now only waiting the construction of the building to be placed in position.

The city council of Georgetown, Tex., has passed an ordinance ordering an election to be held to determine whether $8,000 in bonds shall be issued by the city for the purpose of building an electric light plant to be owned and operated by the city.

The Berkshire Electric Company is installing a 50-light incandescent plant in the country residence of Mr. John D. Hass, of West Stockbridge, Mass. The contract calls for large storage batteries, dynamo and gasoline engine and other fixtures.

A charter has been granted by the state department in Pennsylvania to the People's Light and Power Company, of Jeannette, whose purpose is to build an extensive modern electric plant at that place. Mr. George H. Stevens is the president of the company.

Sheriff D. Q. Strobel has sold at auction, to satisfy mortgages, the plant of the Dolgeville Electric Light and Power Company, of Dolgeville, N. Y. It was sold to Mr. Richard L. Storrs, of Bertram & Storrs, brokers of New York. Mr. Storrs also purchased a quantity of stock consisting mostly of wire.

The Gas and Electric Light Company, of Willimantic, Ct., has completed arrangements for increasing its plant at an expense of $35,000. A large coal gas plant and a new gas holder with a capacity of 100,000 cubic feet are included among the proposed improvements. The land for the enlargement has been purchased.

A number of improvements have been made at the plant of the New Albany Light, Heat and Power Company, of New Albany, Ind., within the last few months. The company found that its old quarters were too small for its rapidly increasing business and was forced to build an addition to the main building in which has been installed a number of additional machines.

The plant of the Columbia Electric Light and Power Company has been sold to the Lancaster County Railway Light and Power Company, of Lancaster, Pa., for the sum of $65,000. Mr. William B. Givin, president of the Lancaster County company, states that as soon as the new power station in Lancaster is completed the company will abandon the present power plant at Columbia and furnish both light and power to that point from Lancaster, sending out current at 10,000 volts and using a step-down transformer.

TELEPHONE AND TELEGRAPH

The organization of an independent telephone company is being agitated in Wytheville, Va.

Chancellor McTee has made an order for the sale of all the property of the Home Telephone Company in the foreclosure proceedings instituted by the Morton Trust Company, of New York. The telephone company was recently absorbed by the Interstate Telephone Company, which will be the purchaser.

The Salamanca Telephone and Telegraph Company, of Salamanca, N. Y., has made arrangements for long-distance connection with the Inter-Ocean toll lines, which have recently been extended to Little Valley, the county seat of Cattaraugus County. This will put the entire county into communication with the county offices and will greatly facilitate court work.

The United Telephone and Telegraph Company of Pennsylvania is making arrangements to extend its long-distance lines from Williamsport to Elmira, N. Y., and to connect at that point with the southern New York state through lines of the Inter-Ocean company. This connection will put New York state into direct communication with the entire central portion of Pennsylvania.

The Citizens' Telephone Company and the Elmira Telephone Company, of Elmira, N. Y., have consolidated. It is said that agreements have been reached by which the Elmira Telephone Company is to take the Citizens' company's business within a short time. The Citizens' employés have been paid off and all work on that line stopped. Employés of the Elmira company are also assisting in making an inventory of the Citizens' company's property and materials on hand.

Lawton, I. T., has had telephone communication with the outside world since August 21 through the line which runs from Lawton to Marlow, I. T., owned by the El Reno & Topeka Telephone Company, which concern now has a full local exchange in operation at Lawton, Hobart, Anardarko and other points. This company was on the ground at the start, hauling all supplies by wagon and in spite of injunctions, wire cuttings and other unpleasantries, is said to have given quick, prompt service to the outside world from within a few days after Lawton was opened and before the lots were sold.

The officers of the Belmont Telephone Company, of Belmont, N. Y., have decided to remodel its plant by putting in an entirely new equipment. They anticipate a large increase in the list of subscribers, and expect soon to have in the neighborhood of 200 'phones in operation. There is a movement on foot for the extension of the long-distance service of the Inter-Ocean Telephone and Telegraph Company from Belmont into northern Pennsylvania, giving connections with the important towns in that section, including Coudersport, Warren, Smethport, Meadville, Wellsboro, Towanda and Montrose.

Local capitalists of Bradford, Pa., have just organized the Bradford Telephone Company to build exchanges and operate toll lines through this county and to connect at Athens with the long-distance service of southern New York. It is the intention of those interested in the Bradford company to extend its lines to Scranton and to connect at that point with the lines of the Inter-State Telephone Company, operating in eastern Pennsylvania and New Jersey. When the company's plans have been carried out all important points in southern New York, such as Salamanca, Friendship, Belmont, Wellsville, Andover, Hornellsville, Corning, Elmira, Ithaca, Syracuse, Geneva and others, will be in direct communication with the entire northern section of Pennsylvania and with Philadelphia.

ELECTRICAL SECURITIES

There was considerable fluctuation in Wall street quotations during the week just closed, but the market closed on Saturday, September 28, quite strong, but slightly lower than the previous Saturday. The sensational break of over 7 points in Amalgamated Copper stock on Monday, and the subsequent steady advance of Vanderbilt issues were the leading features of the stock market during the week. Few changes appeared except those influenced by these movements. The cutting off of the extra dividend and manipulation caused the copper decline. A period of comparative inactivity may fairly be expected in view of the fact that a large proportion of the crops have been already virtually marketed, the fall dividends have been declared, the uncertainty of the course to be pursued by President Roosevelt has been cleared away, and there is very little that can be calculated upon to affect the market either way in the near future. Considerable interest is displayed in the question of the dividends to be declared this week on the United States Steel shares, but the published earnings of the corporation for the last three months have removed all uneasiness from that quarter. Orders for many months ahead have been booked. The weekly bank statement was very favorable and better than anticipated. The bank clearings were 25 per cent larger than in the previous week, and 50 per cent larger than one year ago. The Clearing House banks have a surplus of $16,293,000 above legal requirements.

ELECTRICAL SECURITIES FOR WEEK ENDING SEPTEMBER 28.

New York:	Closing.
Brooklyn R. T.	67
Con. Gas	219¾
Gen. Elec.	260
Man. El.	123¼
Met. St. Ry.	164
Kings Co. Elec.	197½
N. Y. & N. J. Tel. Co.	175
Telep., Tel. & Cbl. Co.	6

The directors of the New York & New Jersey Telephone have declared the regular quarterly dividend of 1½ per cent, payable October 15 to stockholders of record October 5.

President Thomas, of the Telephone, Telegraph and Cable Company, says: "Mr. C. W. Morse alone can answer the question as to whether he will acquire control of our company. A proposition was made by Mr. Morse under certain conditions. This conditional proposition was accepted by two-thirds of the stockholders." Mr. C. W. Morse says: "I am not yet prepared to say whether I will take over the property."

Later, on Tuesday of this week, Mr. Morse announced that he had purchased the company and would actively enter the telephone field.

Boston, September 28:	Closing.
Am. Telep. & Tel.	164
Erie Tel.	42
New Eng. Tel.	135
Mass. Elec. pf.	91½
Westing. Mfg. pf.	79
Edison Elec.	250

Philadelphia, September 28:	Closing.
Elec. Co. of America	7¼
Philadelphia Elec.	5⅜
Union Traction	28½
United G. I. Co.	115½
Elec. Stor. Bat. c.	71
Elec. Stor. Bat. pf.	78

Chicago, September 28:	Closing.
Chicago Edison Light	168
Central Union Telephone	45
Chicago Telep.	265
Un. Trac.	17⅜
Un. Trac. pf.	58
Metropolitan El.	92½

PERSONAL MENTION

DR. EI JIAOYAGI, of the University of Kioto, is at present in the United States investigating methods for the application of electricity.

MR. CHARLES SPRAGUE, of the manufacturing house of Chase-Shawmut Company, Boston, is absent from his desk on an extended vacation.

MR. ELISHA SCUDDER, of the Western Electrical Supply Company, St. Louis, has been in the East to accompany his family home from Maine where they have been for the summer months.

MR. F. C. A. SUTOR, manager for Hugo Reisinger, of New York, N. Y., importer of carbon, has returned to New York after an extended trip abroad.

MR. RICHARD VARLEY, of the Varley Duplex Magnet Company, Phillipsdale, R. I., is visiting in the West, with headquarters in Chicago, for a few days.

MR. W. S. GRAFFAM, B. S. (Worcester Polytechnic Institute), has been appointed superintendent of shops in the Clarkson Memorial School of Technology, of Potsdam, N. Y.

MR. AARON FRENCH, the Pittsburgh manufacturer, by whom large gifts to the Georgia School of Technology have been made, has established a third scholarship in that institution.

MR. A. J. WISE, president of the Bunnell Telegraphic and Electrical Company, of New York, N. Y., entertained friends on board his steam yacht Chetolah, during several of the international races.

MR. WILLIAM B. McCURDY and wife are making a tour of the great lakes, thence to Adrian, Mich., to meet the officers of the International Specialty Company, of which he is the eastern manager.

PROFESSOR EDWIN HAVILAND, JR., B. S. (Swarthmore), M. A. (Cornell), has been appointed to the chair of civil engineering in the Thomas S. Clarkson Memorial School of Technology, at Potsdam, N. Y.

MR. E. H. ABADIE, the general sales manager of the Wagner and Bullock electric manufacturing companies, is sojourning in New York city for a few days. The business of his two companies, Mr. Abadie reports to be extremely gratifying.

MR. NORMAN C. SAWYERS AND MR. DUNCAN McNAUGHT, of the India Rubber, Gutta Percha and Telegraph Works Company, Limited, of Silvertown, London, England, have sailed for England after some 30 days' sojourn in the United States.

MR. JAMES L. PUTNAM, assistant general manager of the Clark Automatic Telephone Switchboard Company, Providence, R. I., is making a trip through the Middle West in connection with several installations of this company's automatic telephone system.

MR. E. B. FISHER, of Grand Rapids, and MR. J. B. WARE, of Detroit, prominent telephone men of Michigan, were recent New York visitors. An independent exchange is being installed in Detroit by Mr. Ware, which will be ready for operation early next year.

MR. C. BETRAM FUNCK, of Lebanon, Pa., will shortly enter upon the business of selling electrical supplies and attending to electrical work in that city. Mr. Funck was formerly associated with Mr. H. G. Louser and with him established the Lebanon Electric Company.

MR. MORRIS W. MEAD has retired from the office of superintendent of the Bureau of Electricity of Pittsburgh, and it is understood will enter into active electrical work. Mr. Mead is well known in electrical circles and has been for many years at the head of the electrical department of his city.

MR. R. C. P. HOLMES, purchasing agent of the Chicago Edison Company, is confined to his home by an injury received in falling from a train. His recovery will be a matter of several weeks, as three of his ribs and his collar bone were broken. His many friends will wish for a speedy recovery.

MR. WALTER ABBOTT has resigned as treasurer of the Erie Telegraph and Telephone Company and the subsidiary companies to enter other business. Mr. John Balch has been appointed treasurer in his place. Mr. Abbott will continue as a director of the Erie and subsidiary companies.

MR. M. WAMPLER has accepted a connection with the railway supply department of the Stuart-Howland Company, of Boston. Mr. Wampler has been connected with the Union Railway Company, of New York; the Atlantic Avenue Railroad in Brooklyn, and later with the Peckham Manufacturing Company.

MR. H. DURANT CHEEVER, of the Okonite Company, is enjoying the international yacht races on board his handsome schooner, the Sylph. Quite a party of his friends were entertained on board during the exciting and close contest last Saturday. Mr. Cheever is an authority in yachting circles, and is a member of the New York Yacht Club.

MR. JOHN A. ANDERSON, manager of the Western Union Telegraph Company and the Central Union Telephone Company, in Marion, Ind., will, after October 1, 1901, manage the local business of the Western Union Telegraph Company only. He has tendered his resignation to take effect on that date. Mr. J. E. McGillivray, of Chicago, Ill., will succeed him as manager of the Central Union Telephone Company.

MR. AND MRS. FRANK G. BOLLES, of Norwood, Ohio, celebrated their crystal wedding anniversary on September 21. Mr. Bolles is well known in the electrical profession as the manager of the Advance Department of the Bullock Electric Manufacturing Company, of Cincinnati, Ohio. The happy occasion was marked by the presence of many friends and the receipt of numerous presents of the sort most fitting to commemorate a crystal wedding.

MR. HENRY L. SHIPPY and MR. KARL G. ROEBLING, of the John A. Roebling's Sons Company, are entertaining a number of their electrical friends during the yacht races on board their steam yacht, the Nerita. Among their guests on the opening day were Mr. C. C. Martin, of the Brooklyn Bridge; Mr. J. C. Reilly, general superintendent of the New York & New Jersey Telephone Company; Mr. Herman Salt and Major Robert Edwards, Jr., of the Western Electric Company; Mr. W. T. Bouchelle and Mr. John J. Carty and Mr. John Carty, Jr., of the New York Telephone Company; Mr. Calvin W. Rice, of the New York Edison Company. Mr. William W. Whitney, of the Cambria Steel Company, of Philadelphia, Pa., was also one of the guests.

OBITUARY NOTICE

MR. WALDRON SHAPLEIGH, a well-known industrial chemist in Philadelphia, died in Maine, on August 30. Mr. Shapleigh was born in Philadelphia in 1848, and from 1868 to 1872 was assistant professor of chemistry at the Omaha University. He then studied abroad and was connected first with the King's County Sugar Refinery and later with the Welsbach Company. He was an authority on the rare earths.

INDUSTRIAL ITEMS

THE VARLEY DUPLEX MAGNET COMPANY, of Phillipsdale, R. I., has changed the office of its Chicago manager to 82 Lake street.

THE SANGAMO ELECTRIC COMPANY, of Springfield, Ill., has found the demand for its meter so strong that an enlargement of its plant will be necessary.

THE ELECTRIC APPLIANCE COMPANY, Chicago, has a neat catalogue devoted exclusively to telephone and annunciator systems. It comprises much data on that subject.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, of Pittsburgh, Pa., has received the contract for the electrical apparatus for the new municipal electric light plant in Chester, Pa.

THE STANDARD PAINT COMPANY, New York, has just issued a unique little booklet with testimonials of rubberoid; also data showing the many applications possible for rubberoid in the construction of foundries and manufacturing plants.

A. L. IDE & SONS, of Springfield, Ill., are building a new foundry which will double the capacity of that part of their already large factory. New machinery will also be installed in the shops, so that the growing demand for their engines may be promptly met.

THE CENTRAL ELECTRIC COMPANY, of Chicago, Ill., claims for the Columbia lamp, high efficiency, long life, uniform candle-power and even distribution of light. The company solicits trial orders from those who have not tried the lamp, and assures all customers a prompt shipment of orders.

THE MANHATTAN RAILWAY COMPANY, of New York, N. Y., has awarded the contract to the Siegrist Lubricator Company, of St. Louis, Mo., to install the Siegrist system of automatic lubrication for the entire plant of 96,000 horse-power. The company has also secured a large order from the DeBeers Mining Company, of South Africa.

THE IRON CITY ENGINEERING COMPANY, of Pittsburgh, Pa., contracting engineers and manufacturers' agents, has been distributing a two-foot rule containing also the measurements of the metric system and a number of formulæ concerning mechanical engineering data. This company has just closed two large contracts in western Pennsylvania for steam and electrical apparatus.

THE SCHWERDTLE STAMP COMPANY, of Bridgeport, Ct., is issuing a pamphlet describing its hand-made steel stamps, letters and figures, sample impressions of steel stamps, stock alphabets and figures, and steel presses. In addition to the lines illustrated in the catalogue the company announces that it is making a specialty of factory work, and cutting letters on dies furnished to it.

THE PHOSPHOR BRONZE SMELTING COMPANY, of Philadelphia, Pa., is issuing a very attractive booklet describing its roll and sheet phosphor-bronze, phosphor-bronze wire in coils, fine wire on spools, etc. This material is also used for phosphor-bronze hardened cast pump rods and phosphor-bronze wire ropes. This booklet contains lists and sizes of the products manufactured, and will be found very useful to all those desiring to purchase such materials.

THE KEYSTONE ELECTRICAL INSTRUMENT COMPANY, of Philadelphia, Pa., is manufacturing a fine line of portable ammeters for direct-current circuits, switchboard galvanometer and ground detector for constant-potential circuits, designed to indicate the presence of a ground on a line and made for use on both direct and alternating-current circuits, portable voltmeters for direct-current circuits, and dead-beat portable voltmeters for direct and alternating-current circuits.

THE LEROY PUBLISHING COMPANY, of New York, N. Y., is compiling the twelfth annual volume of the "Buyer and Seller"—the railroad, telegraph, electric and steamship builders' directory. This is an old work with a wide reputation. It is extremely valuable to railroad purchasing agents, mechanical, civil and mining engineers, builders of steamships, railroads, electric traction lines and power plants, contractors and constructors of waterworks, docks, bridges, buildings and subways.

THE COLLYER INSULATED WIRE COMPANY, Pawtucket, R. I., has tripled its manufacturing facilities within the last 12 months, and the last installment of the new machines will soon be in operation. This company has for some years been manufacturing a slow-burning weather-proof wire known as the I. K. L. brand, and the recent increase in the demand for its product has necessitated this enlargement. The company's western representative is the Central Electric Company, of Chicago.

THE SHELBY ELECTRIC COMPANY, of Shelby, Ohio, has had such an increase in its incandescent lamp business in New York that it has been necessary for it to have additional space for its office work and stock. Its new address in New York is the Parker Building, Fourth avenue and Nineteenth street. It is installing in its new office the most complete incandescent lamp testing laboratory in the United States. This is to be fitted with a specially made laboratory photometer with spherical candle-power device now being made by Queen & Company, of Philadelphia, Pa. The instruments for the laboratory are being especially made by the Weston Electrical Instrument Company, of Waverley Park, N. J. The company has gone to no small expense in this laboratory and has run separate circuits to it for perfect regulation.

GOODCHILD & WELSH, 275 to 277 Broome street, Newark, N. J., are manufacturers of the G. & W. incandescent lamps. This new lamp is said to give the highest satisfaction to all customers and well maintains its efficiency and candle-power. An unfortunate typographical error occurred in the advertisement of this house which appeared in the ELECTRICAL REVIEW of September 21, transposing the expression of a customer which should have been "We can get *no* better lamps than those made by Goodchild & Welsh" to "We can get *on* better lamps," etc. It is seldom that transposition of the letters in a two-letter word can make as much difference in meaning as it did in this case. Our apologies are due Messrs. Goodchild & Welsh, and we are pleased to say that such annoying errors do not often happen to the ELECTRICAL REVIEW.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, Pa., appreciating the demand for a battery of small capacity especially adapted to telegraph and fire-alarm service, has placed on the market three types of the chloride accumulator known as B. T., C. T. and P. T. cells, having a capacity of 6, 12 and 24 ampere-hours respectively at the eight-hour discharge rate. These types are of novel construction, the positive and negative plates having their lugs or straps cast or burned together so that the couplet, as it is termed, is shipped to the purchaser in one section by which the only labor required in setting up a battery of these elements is to insert the plates in the jars. This makes the installation a most simple matter, and avoids the necessity of connectors or lead burning. Two plates constitute a complete element of this type, and the simplicity of installing, together with the high standard of excellence which characterizes all types of the chloride accumulator, makes this new type a most modern battery equipment for telegraph and fire-alarm stations. A full description of these cells is found in the new edition of the company's price list.

NEW INCORPORATIONS

VIOLA, MO.—Viola Telephone Company. $10,000.

HOPEDALE, OHIO—Farmers' Home Telephone Company. $2,000.

COVINGTON, KY.—The Cincinnati Telephone Company. $10,000.

CORRY, PA.—Corry Electric Light and Power Company. $10,000.

POTTSVILLE, PA.—Schuylkill County Electric Company. $10,000.

TRUMAN, MINN.—Armstrong Telephone Exchange Company. $25,000.

KUTZTOWN, PA.—Kutztown Electric Light, Heat and Power Company. $1,000.

GREELEY, COL.—Greeley Light and Manufacturing Company. $35,000. Incorporators: William Mayher, S. E. Rogers and others.

DULUTH, MINN.—The North Land Telephone Company. $25,000. To make connections with many of the principal towns of northern Minnesota and Wisconsin.

ZIONSVILLE, IND.—The Citizens' Telephone Company. $10,000. To operate exchanges in Boone, Clinton, Hamilton, Marion, Hendricks and Montgomery counties.

EXETER, N. H.—Newmarket & Exeter Street Railway Company. $75,000. Incorporators: Wallace D. Lovell, Newton, Mass.; Samuel W. Emery, Portsmouth, N. H., and others.

NEOGA, ILL.—Neoga Telephone and Telegraph Company. $2,500. To operate telephone and telegraph lines. Incorporators: A. J. Baugnman, Mamie A. Sheehan and others.

NEW YORK, N. Y.—American Electrite Company. $1,000,000. To manufacture electrite and improved explosives. Directors: Henry H. Whitehead, William B. Keep and others.

NEW YORK, N. Y.—Graham-Fox Motor Company. $500,000. To manufacture motors and automobiles. Directors: Frank A Fox and David S. Graham, Stamford, Ct., and others.

INDIANAPOLIS, IND.—The Cincinnati & Indianapolis Traction Company. $10,000. To connect Indianapolis and Cincinnati with an electric railway. Mr. J. C. Hoover is its president.

TRENTON, N. J.—Railway Construction and Improvement Company. $1,000,000. Incorporators: Ferdinand M. Holmes, Everett, Mass.; Howard W. Burg, Jamacia Plains, Mass., and others.

OAKWOOD, MO.—The Hannibal & Ralls County Telephone Company. To build a telephone line to connect the towns of Ralls County with Hannibal. Directors: J. F. Davidson, S. P. Spalding and others.

DAVENPORT, IOWA—The Iowa & Illinois Railway Company. $125,000. To build an electric or compressed air line from Clinton to Davenport. Mr. F. J. Spencer, of Wauseon, Ohio, is its president.

FORT WAYNE, IND.—Fort Wayne & Lima Traction Company. $50,000. To operate a street railway system in Fort Wayne and to construct an interurban line from Lima, Ohio, to Fort Wayne. Incorporators: D. J. Cable, J. B. Kerr and others.

BUFFALO, N. Y.—New York State Telephone Company. $1,500,000. To maintain lines of electric telephone wholly within or partly beyond the limits of New York state. A general route within the limits of the city of Buffalo is mentioned. Directors: William F. Mackey, of Buffalo, N. Y., and others.

List of Electrical Patents Issued Last Week

[Specially reported for this journal by E. S. Duvall, solicitor of patents, Loan and Trust Building, Washington, D. C. Copies of any patent may be secured for 10 cents each.]

ISSUED SEPTEMBER 24, 1901.

683,045 Electric coupling for conductors; C. Holzman, Budapest, Austria—An electric bond for separated conductors, consisting of a plug spanning the gap between the rails, means for securing the plug to the adjacent rails constructed to permit relative movement of the plug and connections, and said plug being longitudinally slitted.

683,046 Incandescent lamp protector; J. M. Howley, Bayonne, N. J.

683,052 Armature-core for electrical machines; G. Koppleman, Schuttorf, Germany.

683,060 Insulating construction; T. New, Brooklyn, N. Y.—An insulating construction, comprising a block having an outer closed covering and having a plurality of spaced partitions therein, with air spaces between them, each of said partitions being of cellular construction, with a plurality of air spaces therein.

683,062 Enclosing structure for electric arc lamps; W. H. Northall, Elwood, Ind.

683,066 Electric tube-welding machine; O. Parpart, Cleveland, Ohio.

683,085 Manufacture of filaments for incandescent electric lamps; W. L. Voelker, London, England.

683,086 Manufacture of filaments for incandescing electric lamps; W. L. Voelker, London, England.

683,090 Recording clock; F. Williams, Revere, Mass.

683,098 Electric cloth or fabric; L. Baecker, Detroit, Mich.

683,133 Interchangeable electric display apparatus; G. L. Mason, New York, N. Y.—A lamp-box, a removably-seated monogrammic framework, comprising varied shaped compartments that are arranged within a given field in such relative position as to provide means within said field, whereby any letter of the alphabet or numeral can be successively blocked out in light.

683,171 Transmitter for educational purposes; C. S. Comins, Quincy, Mass.

683,172 Electrical block-signal system; S. L. Foster, San Francisco Cal.

683,186 Thermostatic switch; W. F. Singer, New York, N. Y.—Comprises a motor, main line, switch in said line, electrically actuated switch-

(Continued on page 33.)

PATENTS.

Twenty years' continuous practice with the Western Union Telegraph Company, American Bell Telephone Company, General Electric Company, Electrical Accumulator Company, Postal Telegraph-Cable Company, and other electrical companies.

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Examinations made and reports furnished on all classes of industrial properties

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PATENTS.

(Continued from page 31.)

operating mechanism, device for completing circuit whereby said switch-operating mechanism is energized, and thermostat electrically connected with means for releasing said circuit-completing device.

683,213 Electric switch; K. W. Mansfield, South Norwalk, Ct.—A switch-arm normally separated from its cooperating terminals, a movable device adapted to rest in one position, automatic means to strike said movable device a quick blow and move the same to a distance, thereby releasing said switch-arm and causing the same to complete the circuit, and means to cause said movable device to automatically return to its former position and reopen the circuit.

683,214 Signal system; K. W. Mansfield, South Norwalk, Ct.—A pair of solenoids, a core for the same, said core being movable into said solenoids alternately, a movable signal, a connection between said core and signal to move the latter, and including a rotatable shaft having a cam-face, and a portion in contact with said cam-face, and moved by said core to rotate said shaft and throw said signal.

(Concluded on page 34.)

Wanted . . . .

An 800-Kilowatt of Second-hand Direct-Current 225-250-Volt Dynamo, varying from 50 to 250-Kilowatt capacity. Also one 100 Kilowatt, 500 Volts.

Address with full particulars of machinery and prices,

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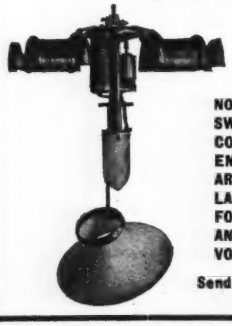

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WASHINGTON, D. C., Sept. 16, 1901.
Sealed proposals will be received here until noon, October 16, 1901, and then publicly opened, for furnishing and installing Electric Elevators for New Building for Government Printing Office. Information furnished on application.
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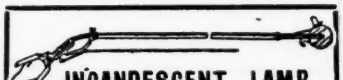

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This folder contains information valuable to travelers regarding Buffalo, the Exposition, and the train service of the New York Central; also maps in colors of Buffalo and the Exposition grounds.

A copy of No. 15, the "Pan-American Exposition and Express" sent free, postpaid, to any address on receipt of a postage stamp by George H. Daniels, General Passenger Agent, New York Central Railroad, Grand Central Station, New York.

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September 17, 1901.

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The new Company has secured offices at 11 Broadway, New York City, and proposes to engage in the purchase and sale of all kinds of Electrical Machinery, Engines, Boilers, Etc., and also to undertake the construction of Electric and Steam Plants and to do General Engineering.

Mr. W. S. Barstow, formerly General Manager of the Edison Electric Illuminating Company of Brooklyn, has been retained as consulting engineer, and will devote a large part of his time to the interests of the new concern.

The Company will have a capital of $250,000 and will be fully prepared to cover all special branches of the business as above set forth.

With thanks for past courtesies, and trusting that in the CHARLES E. DUSTIN COMPANY I may have the pleasure of continuing business relations, I remain,

Very respectfully yours,

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DIRECT-CONNECTED UNITS

110-125 VOLTS

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Open and closed, of all sizes, and for all gauges. *Let us know your wants.*

Lot of 8-Bench Stephenson Open Cars, with Brill or Peckham single trucks for 4 ft. 8½ in. gauge.

Lot of 9-Bench Brill Open Cars, with Brill No. 21 trucks.

Lot of St. Louis Closed Cars, 18 ft. 6 in. long, in first-class condition, for standard gauge.

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4—300-kw General Electric.
1—100-kw General Electric.
1—150-hp M.P. Westinghouse.
1—100-kw Edison.
2—75-kw Thomson-Houston.
2—D62 Thomson-Houston.
2—60-kw Edison.

BELTED DYNAMOS AND MOTORS 110 VOLTS

1—100-kw Westinghouse M.P.
1—50-kw Western Electric.
2—60-kw Edison.
2—45-kw Edison.
3—30 kw Edison.
5—25-kw Edison.
1—20-kw Edison.
1—50-kw Siemens & Halske.
1—30-kw Eddy, M.P.
1—25-kw M.P.-6 Excelsior.
1—22½-kw Westinghouse, M.P.
1—16-kw Lundell.
1—13½-kw American Ball (new).
1—12½-kw Kester, M.P.
1—15-hp Excelsior.
1—15-hp Mather.
1—10-hp M.P. Excelsior.
1—10-hp bipolar Excelsior.
3—D3 T.-H. Bipolar.

BELTED MOTORS 500 VOLTS

2—60-kw Edison.
1—25-hp Keystone, M. P.
1—25-hp Eddy, M. P.
1—12-hp Edison
1—12-hp Jenney.
1—10-hp Mather.
1—9-hp Jenney.
1—2 hp C & C.

BELTED DYNAMOS AND MOTORS 220 VOLTS

1—D62 Thomson-Houston.
1—15-hp Excelsior.
1—10-hp Eddy.
1—10-hp Thomson-Houston.
1—10-hp Lundell.
1—8-hp Excelsior.
1—7½-hp Lundell.
1—3-hp Excelsior.
1—2½-hp Fort Wayne.
1—15-kw Siemens & Halske, for direct connection.

ALTERNATORS

1—300-kw Fort Wayne, 2000 volts, 7200 alternations, single-phase.
1—240-kw Westinghouse, 110 volts, 16,000 alternations, single-phase.
3—150-kw General Electric, monocyclic, 1050 volts, 120-cycle, complete.
2—A120 General Electric, single-phase, 1000 volts, 16,000 alternations.
1—120-kw Westinghouse, single-phase, 2000 volts, 16,000 alternations.
1—100-kw Fort Wayne, 2200 volts, 16,000 alternations.
1—75-kw Stanley, 2000-1000 volts, two-phase, 16,000 alternations.
2—60-kw General Electric, single-phase, 1100 volts, 16,000 alternations.
2—60-kw Westinghouse, single-phase, 16,000 alternations, 1100 volts.
1—45-kw Westinghouse, 2200 volts, 16,000 alternations.
1—45-kw Westinghouse, 1100 volts, 16,000 alternations.
2—A-35 General Electric, single-phase, 16,000 alternations, 1050 volts.
2—A-30 General Electric, single-phase, 16,000 alternations, 1050 volts.

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2—165-Lt. multi-circuit Brush, 1200 c. p.
3—120-Lt. multi-circuit Brush, 1200 c. p.
1—80-Lt. single-circuit Brush, 2000 c. p.
1—M. D. 12, 75-light, T.-H. 1200 c. p.
T.-H. and excelsior, all sizes.

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2—16x16 Erie Ball.
3—15½x15 Armington & Sims.
1—14x13 Armington & Sims.
2—13x14 Watertown.
2—12x12 Erie Ball.
1—8x13x8 Westinghouse.
1—10x14 Buckeye.
1—8x12 Atlas.
1—6x8 Chandler & Taylor.

BOILERS

Water Tube and Return Tubulars.

ROSSITER, MACGOVERN & CO. 141 BROADWAY, N. Y. CITY
FACTORY: JERSEY CITY, N.J.

PATENTS.

(Concluded from page 32.)

683,216 Therapeutic battery; J. A. Minturn, Indianapolis, Ind.

683,230 Electric circuit-closer for railway tracks; F. Sock, Magdeburg, Germany.

683,250 Electric rail-bond; S. P. Cowardin, Richmond, Va.

683,253 Electric generator or motor; P. J. Darlington, Montreal, Canada.

683,257 Electric programme clock; B. Dubinski, San Antonio, Tex.

683,263 Electrolytic production of cathode plates; E. G. Elliott, Perth Amboy, N. J.

683,279 Control system for electric cars; C. Hochenburg, Vienna, Austria —A plurality of motor-cars in a single train, controllers for the propelling motors of the train, controller actuating means operated by contact with the roadway, and means upon a single car for operatively connecting the controller actuating means with the controllers upon the several cars.

683,283 Electromagnetic traction-increasing apparatus; A. A. Honey, Tacoma, Wash.

683,284 Electromagnetic brake; A. A. Honey, Tacoma, Wash.

683,319 Burglar alarm; W. G. McClure, Beaver Falls, Pa.

683,332 Electromagnetic brake; A. A. Robertson, Titusville, Pa.

683,341 Electric alarm mat; A. D. Shaw, New York, N. Y.

683,397 Signaling mechanism; R. Herman, Crafton, Pa.—A signal having a bias to danger position, electrically operated mechanism for electrically locking the signal at caution and clear positions, and a circuit-controller operated by the driving means for controlling the lock-circuit during the movement of the signal from danger to clear position, means normally acting to operate the circuit-controller during the movement of the signal from clear to danger position.

Bullock Dynamos

WANTED—SEVERAL PERSONS of character and good reputation in each state (one in this county required) to represent and advertise old established wealthy business house of solid financial standing. Salary $18.00 weekly with expenses additional, all payable in cash each Wednesday direct from head offices. Horse and carriage furnished, when necessary. References. Enclose self-addressed stamped envelope. Manager, 316 Caxton Building, Chicago.

NOTICE is hereby given that the annual meeting of the Stockholders of the Electrical Review Publishing Company, for the election of Board of Directors for the ensuing year, and the transaction of such other business as may properly come before the meeting, will be held at the offices of the company, Nos. 13-21 Park row, in the City of New York, on the 12th day of October, 1901. The polls will be opened at three o'clock and closed at four o'clock, P. M.

STEPHEN H. GODDARD,
Secretary.

September 23, 1901.

Bullock Power Plants

THE ELECTRICAL REVIEW has received more new subscribers in the last six months than at any similar period of its twenty years of existence.

Bullock Motors

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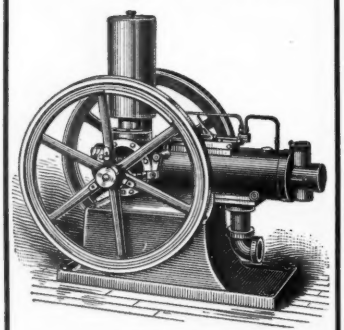

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